NOTICE

All drawings located at the end of the document.

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FINAL DRAFT

POND WATER MANAGEMENT
INTERIM MEASURES/INTERIM REMEDIAL ACTION
DECISION DOCUMENT

U.S. DEPARTMENT OF ENERGY

EG&G ROCKY FLATS, INC.

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ACRONYMS

LIST OF ACRONYMS AND ABBREVIATIONS

ACL	Alternate Concentration Limit
af	Acre-Feet
ANOVA	Analysis of Variance
APEN	Air Pollution Emission Notice
AQCC	Air Quality Control Commission
ARAR	Applicable or Relevant and Appropriate Requirements
AIP	Agreement in Principle
AWQC	Ambient Water Quality Criteria
BAT	Best Available Technology
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BUTL	Background Upper Tolerance Limit
C	Celsius
CAA	Clean Air Act
CAP	Corrective Action Plan
CAQCC	Colorado Air Quality Control Commission
CBOD	Carbonaceous Biochemical Oxygen Demand
CCR	Colorado Code of Regulations
CDPHE	Colorado Department of Public Health and the Environment
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CHWA	Colorado Hazardous Waste Act
CLP	Contract Laboratory Program
cm	Centimeter
CMS	Corrective Measures Study
CMP	Corrugated Metal Pipe
COC	Contaminant of Concern
COD	Chemical Oxygen Demand
CRS	Colorado Revised Statute
CRS	Colorado Revised Statutes
CUHP	Colorado Urban Hydrograph Procedure
CWA	Clean Water Act
D&D	Decommission and Decontamination
DCG	Derived Concentration Guide
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DWD	Denver Water Department
E&WM	Ecology and Watershed Management
EcMP	Ecological Monitoring Program

EDE	Effective Dose Equivalent
EG&G	EG&G Rocky Flats, Inc.
EIS	Environmental Impact Statement
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPIP	Emergency Preparedness Implementation Plan
ERM	Environmental Restoration Management
ESA	Endangered Species Act
FFCA	Federal Facilities Compliance Agreement
FS	Feasibility Study
ft	Foot
FWCA	Fish and Wildlife Coordination Act
FWS	U.S. Fish and Wildlife Service
g	Gram
GAC	Granular Activated Carbon
GFAA	Graphite Furnace Atomic Adsorption
gpd	Gallons per Day
gpm	Gallons per Minute
HazMat	Hazardous Materials
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
HRR	Historical Release Report
HSL	Hazardous Substance List
HSWA	Hazardous and Solid Waste Amendments of 1984
IA	Industrial Area
IAG	Interagency Agreement
ICPES	Inductively Coupled Plasma Emissions Spectrometry
ICPMS	Inductively Coupled Plasma Mass Spectrometry
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
IWMP	Integrated Watershed Management Plan
L	Liter
LANL	Los Alamos National Laboratory
LDR	Land Disposal Restriction
LWO	Liquid Waste Operations
MBTA	Migratory Bird Treaty Act
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MG	Million Gallons
MGD	Million Gallons per Day
MG/yr	Million Gallons per Year

mg/L	Milligrams per Liter
ml	Milliliter
μg/L	Micrograms per Liter
NAAQ	National Ambient Air Quality
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NOV	Notice of Violation
NO_x	Nitrogen Oxide + Nitrogen Dioxide
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
OPPP	Oil Pollution Prevention Plan
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Wastes and Emergency Responses
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PCE	Perchloroethylene
pCi	PicoCuries
PDL	Public Dose Limit
PL	Public Law
POTW	Publicly Owned Treatment Works
PPCD	Plan for the Prevention of Contaminant Dispersal
PPP	Pollution Prevention Plan
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
PSD	Prevention of Significant Deterioration
PVC	Polyvinyl Chloride
RAGS	Risk Assessment Guidance for Superfund
RCG	Radioactivity Concentration Guide
RCRA	Resource Conservation and Recovery Act
RFEDS	Rocky Flats Environmental Database System
RFETS	Rocky Flats Environmental Technology Site
RFI	RCRA Facility Investigation
RFO	Rocky Flats Office
RI	Remedial Investigation
ROD	Record of Decision
RQ	Reportable Quantity
RWO	Regulated Waste Operations
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act

SEO	State Engineer's Office
SID	South Interceptor Ditch
SLPP	Standley Lake Protection Project
SM	Standard Method
SMO	Sample Management Office
SMSOP	Small Mammal Standard Operating Procedure
SOP	Standard Operating Procedure
SOX	Sulfur Oxides
SPCC	Spill Prevention Control Countermeasures
SPPP	Stormwater Pollution Prevention Plan
STP	Sewage Treatment Plant
SU	Standard Units
SVOC	Semi-Volatile Organic Compound
SW	Surface Water
SWMM	Stormwater Management Model
SWMU	Solid Waste Management Unit
SWTMP	Surface Water Toxicity Monitoring Program
TAL	Target Analyte List
TBC	To Be Considered
TCA	Trichloroethane
TCE	Trichloroethylene, Trichloroethene
TCL	Target Compound List
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TRC	Total Residual Chlorine
TRU	Transuranic
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UCL	Upper Confidence Limit
UDFCD	Urban Drainage and Flood Control District
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
VOC	Volatile Organic Compound
WQCA	Colorado Water Quality Control Act
WQCC	Colorado Water Quality Control Commission
WQCD	Colorado Water Quality Control Division
WET	Whole Effluent Toxicity
WMP	Watershed Management Plan
WMPP	Waste Minimization Program Plan
WWTP	Wastewater Treatment Plant

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

This Pond Water Management Interim Measures/Interim Remedial Action (IM/IRA) Decision Document has been prepared to identify, screen, and evaluate appropriate interim remedial action alternatives, and to select a preferred interim remedial action plan for the management of surface water within the drainage ponds of the Rocky Flats Environmental Technology Site (the Site) (Figure 1-1). Specifically, this document addresses the A- and B-series drainage ponds, Pond C-2, and the Landfill Pond. These are the drainage ponds at or near the Site that are most immediately impacted by Site operations. This document was prepared at the request of the Colorado Department of Public Health and Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA) pursuant to paragraph 150 of the Rocky Flats Interagency Agreement (IAG) (the U.S. Department of Energy [DOE], EPA, and State of Colorado 1991). IM/IRAs are normally conducted to address an immediate or potential threat to human health and the environment. No immediate threat associated with the drainage ponds is known or has been identified.

Final remedial actions for the drainage ponds will be conducted as identified in the IAG schedule for Operable Unit (OU) 6 (for the A- and B-series drainage ponds), OU 5 (for Pond C-2), and OU 7 (for the Landfill Pond). The IAG schedule requires the completion of Resource Conservation Recovery Act (RCRA) Facility Investigation/Remedial Investigations (RFI/RIs) and Corrective Measures Study/Feasibility Studies (CMS/FSs) prior to implementation of final remedial actions. It is anticipated that the RFI/RI and CMS/FS studies will be completed in approximately five years, but that implementation of the long-term response action, if any, will most likely follow completion of all decommission and decontamination (D&D) activities at the Site. Therefore, the time frame for implementation of actions proposed in this IM/IRA document is within five years of the completion date of this report, but the implemented actions may remain in place until completion of D&D activities. A public comment process will be implemented prior to undertaking actions recommended in this document.

Overlapping regulatory requirements and programs control the management of surface water and sediment impounded in the drainage ponds at the Site. Many of these requirements and programs, such as spill prevention plans and stormwater best management practices (BMPs), are driven by requirements of the Clean Water Act (CWA). However, a number of programs are driven by other applicable laws, including RCRA (1976), as amended by the Hazardous and Solid Waste Amendments of 1984, and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (1980), as amended by the Superfund Amendments and Reauthorization Act of 1986. These requirements address issues such as remediation of contaminated groundwater and soils near the drainage ponds and remediation of contaminated sediments within the ponds.

Although both the current CWA and RCRA/CERCLA activities at the Site seek to minimize the potential for pond waters to become contaminated, the potential exists nonetheless. Therefore, the overall goal of this document is to identify and evaluate options that will effectively manage pond water quantity and quality until all IAG-related CMS/FS remedial actions are studied and fully implemented.

The process followed in the identification, screening, and evaluation of appropriate remedial actions as presented in this document is consistent with EPA guidance and reference documents specific to this process or to the Site (EPA 1990, 1991, 1993). Specific pond management techniques evaluated in this document include spill control options and options that address storage, treatment, volume reduction, transfers, monitoring, and discharges of pond water. The pond management techniques identified in this document must be consistent with IAG remediation efforts for OUs 5, 6, and 7, as well as forthcoming National Pollutant Discharge Elimination System (NPDES) permits which address both the wastewater treatment plant (WWTP) point-source outfall and stormwater sources. By directly addressing water quality and volume management, this document indirectly addresses all influent water sources to the ponds, including stormwater, base flows in the streams, WWTP discharges, spills, footing drain flows, seeps and/or springs, and groundwater flows captured by the ponds.

1.2 REGULATORY FRAMEWORK FOR POND WATER MANAGEMENT AT THE SITE

A number of regulatory requirements and guidance documents currently govern the monitoring, assessment, clean-up, and management of water and other natural resources at the Site. More than 25 major federal and state laws apply to the management of water and water-related ecosystems. Table 1-1 lists the appropriate laws and guidance for the development of this Pond Water IM/IRA document.

The compliance provisions that most directly affect pond management include: (1) NPDES, as modified by the Federal Facilities Compliance Agreement (FFCA), (2) the Colorado Water Quality Control Commission (WQCC) standards, and (3) the Agreement in Principle (AIP). These guiding documents and other regulatory requirements are discussed herein.

1.2.1 National Pollutant Discharge Elimination System (NPDES)/NPDES-FFCA

Under the CWA, either the Administrator of EPA or states with approved programs issue NPDES permits that control and limit the discharge of any pollutant to "waters of the United States." The State of Colorado has authority to issue permits for discharges of pollutants to surface waters pursuant to the CWA and the Colorado Water Quality Control Act (WQCA).

CDPHE, through its Water Quality Control Division (WQCD), administers the state NPDES program. Because states do not currently have the authority to issue NPDES permits for federal facilities, EPA Region VIII in Denver issues and administers the NPDES permit for the Site. However, Colorado is required to promulgate stream standards for waters of the state, and these stream standards are generally incorporated into federal NPDES permits. The State of Colorado is also required to certify that NPDES permits issued by EPA for federal facilities comply with Colorado stream standards.

The current NPDES permit (CO-0001333) expired on June 30, 1989. The Site filed a timely application for renewal and is operating under a statutory extension until a renewal permit is issued by EPA. The current permit specifies monitoring requirements and effluent limitations for discharge outfalls from Ponds A-3, A-4, B-3, B-5, C-2, and the WWTP (Figure 1-2).

In March 1991, an FFCA was signed by DOE and EPA which modified the Sites' NPDES permit. The purpose of the combined NPDES-FFCA is to achieve and maintain compliance with water pollution control standards included in the Sites' NPDES permit and to strictly regulate the treatment and discharge of sanitary wastewater. The FFCA mandates four general activities to reduce the possibility of an inadvertent release of hazardous substances to the WWTP and, subsequently, to downstream waters. These activities have been completed or are in progress, according to defined schedules.

1. Upgrades to the WWTP, including improved sludge handling, instrumentation, influent/effluent management, and nitrification/denitrification;

2. Monitoring upgrades via a *de facto* modification of the plant's NPDES permit, including a requirement for whole effluent toxicity (WET) testing;

3. Testing of the water and soil beneath the WWTP sludge drying beds for possible contamination; and

4. Development of a comprehensive strategy for limiting hazardous materials and toxic substances releases to the WWTP through implementation of the recommendations of DOE's report responding to the 1989 chromic acid incident.

The NPDES-FFCA also changed a monitoring point and certain parameters in the NPDES permit. Monitoring for biochemical oxygen demand at Pond B-3 was discontinued under the FFCA and has been replaced with monitoring for carbonaceous biochemical oxygen demand at the WWTP outfall to provide a more accurate measurement of WWTP performance. The WWTP must also demonstrate compliance through a self-monitoring program.

1.2.2 Colorado Water Quality Control Commission Standards

The WQCA created the WQCC and WQCD to establish use classifications and water quality standards for waters of the state. On July 10, 1989, the WQCC held an emergency hearing on classifications and standards for Woman Creek and Walnut Creek. As a result of this hearing, Stream Segments 4 and 5 were created under the Big Dry Creek basin, and a water supply classification was adopted for tributaries to Great Western Reservoir and Standley Lake. These tributaries include the main stems of Woman Creek and Walnut Creek and their tributaries, excluding those identified in Segment 5. Segment 5 includes the main stems of North Walnut Creek and South Walnut Creek, including all tributaries, lakes, and reservoirs from their sources to the outlets of Ponds A-4 and B-5 on Walnut Creek and Pond C-2 on Woman Creek. Segment 4 represents stream reaches downstream of the ponds (Figure 1-2).

In December of 1989, the WQCC held an important hearing to discuss establishing permanent classifications and standards for Segments 2, 3, and 4 of Big Dry Creek. In January of 1990, the WQCC formally adopted the new classifications and standards for the streams located on the Site and for Standley Lake (Segment 2) and Great Western Reservoir (Segment 3). The standards for the Site were amended in September 1991 to reflect changes in statewide standards.

In December 1992, the WQCC concluded its hearings in which stream standards for Segment 5 of Big Dry Creek were established. The WQCC accepted a WQCD proposal to impose Segment 4 standards with temporary modifications for nine parameters, including a numeric level for un-ionized ammonia. The WQCC accepted several additional modifications to Segments 4 and 5 standards put forth by DOE and EG&G Rocky Flats, Inc. (EG&G) to make site-specific standards consistent with statewide standards for organic constituents. The WQCC also adopted a standard for beryllium. These standards are applicable until April 1, 1996.

The above discussion of stream segments and standards is important for a number of reasons. Stream standards for point discharges are generally enforceable through incorporation as effluent limitations in a valid discharge permit. The current discharge permit pre-dates the establishment of numeric stream standards for the receiving streams by the WQCC. Therefore, these standards are not currently included as effluent limitations for discharges from the ponds.

Secondly, it is important to note that legal compliance with standards is judged by monitoring at the point of permitted discharge, and not in the receiving stream. However, it is also true that CDPHE frequently uses monitoring data of streams to infer either unsatisfactory compliance or insufficiently stringent permit limits.

Notwithstanding the above discussion, DOE and EG&G currently use the applicable WQCC Segment 4 and Segment 5 stream standards as the primary guidance for general pond water management activities and discharge operations and will continue to do so in the future.

1.2.3 Agreement in Principle

The AIP between DOE and CDPHE was signed on June 28, 1989. The agreement is an extension of a Memorandum of Understanding that was signed between DOE and Colorado in 1979 which formalized existing arrangements for independent monitoring and assessment of terminal ponds by the state prior to discharge. It is important to note that the AIP is an "agreement" and, as such, is not legally enforceable. The AIP adopted existing programs and created substantial new commitments by DOE, further formalizing an already existing program of independent monitoring and oversight of the Site by CDPHE. With respect to plant surface water discharges, the AIP was designed to assure citizens of Colorado that any discharges from the Site will not adversely affect public health and safety or the environment. The AIP was due to expire September 30, 1994, but was extended for a 90-day period by both parties.

Under the AIP, CDPHE tests for inorganic and organic chemicals and radionuclides in the ponds and the drinking water reservoirs immediately downstream of the Site. Before any water is discharged from the ponds, DOE notifies CDPHE, and split samples are taken for analysis. The AIP does not give CDPHE legal authority to "approve" discharges from the ponds. However, in the interest of fostering an atmosphere of trust and cooperation, DOE generally waits until CDPHE concurs with the acceptability of water quality, as measured against Segment 4 stream standards, before discharging water from the ponds. The AIP also requires DOE to conduct a study of possible methods for eliminating discharges to surface waters at the Site. Pursuant to this provision of the AIP, a zero-discharge study was recently completed by the Site in 1992. These studies concluded that zero discharge of water effluents from the Site was not feasible given the physical and regulatory limitations that currently exist.

1.2.4 Other Regulatory Requirements and Guidance Documents

Other regulatory requirements and guidance documents which are considered in the course of current pond water management include the IAG, the National Contingency Plan (NCP), administrative requirements of the CWA, DOE orders, and Colorado statutes concerning dam safety. Pond management practices must be coordinated with ongoing CERCLA and RCRA activities. State dam safety statutes govern the construction, maintenance, and operation of dam structures. DOE orders cover a broad range of topics including control of radionuclide discharges, worker health and safety, and general environmental protection. In addition to permitting actions, CWA also requires the preparation of Pollution Prevention Plans (PPPs) and the implementation of BMPs to control pollutants and ensure on-site activities at the Site are in accord with practices recommended by field professionals.

1.2.5 Interagency Resolution Defining the Scope and Limitations of the IM/IRA Document

The dispute resolution process between DOE, CDPHE, and EPA was initiated for the purpose of resolving which specific activities associated with water management at the Site were applicable to this IM/IRA, and which activities were more appropriately delegated to other programs. The dispute resolution process was concluded in April 1994. It was agreed that OU 7 activities would address interim actions at the Landfill Pond for control of an OU 7 leachate seep, that new tank storage capacity for spills and WWTP upsets would be addressed as part of the Industrial Area (IA) IM/IRA, and that this document would specifically address pond water management issues. The following statements from the dispute resolution document are pertinent to the technical aspects of this document.

1. The administrative controls identified in this document will not become effective until the NPDES controls (established in the current NPDES permit) are no longer in effect. A new NPDES permit is expected to be completed for the Site in the near future. The administrative controls identified in this document will apply to pond water management downstream of the outfalls specified in the new NPDES permit.

2. The parties agree that extreme or prolonged precipitation events may result in water levels that threaten the integrity of the dam structures. If such climatic circumstances should occur, DOE will implement alternative water management practices, as incorporated in the Pond Water IM/IRA, to maintain the safety and security of the dam structures. When a situation arises that requires action, DOE will notify CDPHE and EPA prior to taking any action.

3. The parties agree to specify when alternative water management practices (e.g., controlled volume releases) will be used, what those water management practices will be, and how and when EPA and CDPHE will be notified of the implementation of the alternative water management practices. In addition, the parties agree to specify within the Pond Water IM/IRA a protocol to characterize, pursuant to RCRA and CERCLA, and, if necessary, to remediate releases into the environment resulting from alternative water management practices.

4. The parties agree that alternative water management practices incorporated within this document are consistent and in compliance with the IAG and other environmental regulatory requirements.

Given these statements, the Pond IM/IRA describes the variables related to surface water control and the appropriate responses to reasonably anticipated surface water control problems. Thus, this document is essentially an administrative control document, and it is not a plan for remediation of an existing problem.

1.3 HISTORY OF POND WATER MANAGEMENT AT THE SITE

During the history of the Site, 16 on-site ponds have been used for the detention and sampling of water prior to off-site discharge. These ponds also allow for the retention of spills that might occur on the plant site, thereby minimizing immediate off-site releases. Of the 16 drainage ponds built, 12 still exist, and 11 are addressed in this document. Pond C-1 is not addressed because it is a small flow-through pond on Woman Creek that at the current time should not be impacted by Site operations. This pond was effectively isolated from the Site when the South Interceptor Ditch (SID) was constructed in 1979. The drainage ponds are illustrated in Figure 1-2.

Prior to 1974, off-site discharges from ponds were unregulated by outside agencies but were monitored to determine their quality relative to drinking water standards and radioactivity concentration guides (RCGs). RCGs are defined as allowable or recommended maximum radionuclide discharge concentrations based upon dose considerations. DOE replaced RCG radionuclide discharge concentrations with derived concentration guides (DCGs) in 1985. Since 1974, off-site discharges from drainage ponds, and many of the operations related to the drainage ponds (such as spray evaporation and irrigation activities), have been regulated by an NPDES permit for non-radionuclide analytes.

In November 1986, a RCRA Part B permit application was filed by DOE for the Site. As a portion of that permit application, previously or currently used Solid Waste Management Units (SWMUs) were identified. According to the guidance available to the Site at that time, the A-, B-, and C-series drainage ponds and related drainages were identified as SWMUs in the permit application.

In 1991, an IAG was signed for the Site. In this IAG, the term Individual Hazardous Substance Site (IHSS) was introduced to refer to the sites at which contaminants might be present due to past spills or past operational practices. Sites identified earlier as SWMUs became IHSSs, and all IHSSs were grouped into 16 OUs. The IAG specified schedules for investigation and possible remediation for the OUs. As IHSSs, the A-, B-, and C-series ponds were grouped into OU 5 and OU 6. The Landfill Pond was later identified as an IHSS site to be addressed in OU 7 activities.

In June and October 1992, DOE was notified by EPA and CDPHE that the basic regulatory framework for water management in the drainage ponds under the NPDES program would change substantially. A new NPDES permit would regulate WWTP and stormwater discharges from the developed portion of the Site prior to entering the A-, B-, and C-series ponds. The NPDES permit has historically regulated discharges from the ponds rather than discharges to the ponds. The agencies also indicated that discharges and operational management of the drainage ponds would be regulated by the requirements identified in an IM/IRA until final actions for these ponds are implemented as a part of the OUs 5, 6, and 7 IAG-related activities.

Currently, the basic goal of water management at the Site is to ensure that operations and activities are conducted to minimize impacts to human health and the environment, while achieving and maintaining compliance with current environmental laws and regulations. This goal remains constant even as management methods and practices, physical facilities, and regulatory requirements have changed over time. The general approach to water management consists of the following practices:

1. Divert upstream storm drainage and irrigation ditch flows around the developed plant site to hydraulically isolate the IA and reduce the volume of water subject to intensive on-site monitoring and management.

2. Capture and retain stormwater and other flows, as well as transported sediment from the developed plant site area, in the retention ponds. Prior to release, ensure pond water complies with relevant standards.

3. Maintain the capability to divert and isolate potentially contaminated flows for sampling, analysis, and disposition, thereby protecting downstream ponds and receiving waters.

4. Rigorously implement source controls for point and non-point contaminant sources potentially affecting surface water.

5. Implement state-of-the-art technologies for pond monitoring, modeling, treatment, and water quality management.

6. Maintain dam safety to ensure, to the extent possible, that health, safety, and the environment are protected.

Implementation of these policies protects downstream water users and the general public. Numerous documents describe and establish how pond water is best managed in the context of the above policies. However, the above policies can be contradictory to each other and, therefore, must be applied appropriately. For instance, detention of water to allow for monitoring reduces the capacity for stormwater capture and flood control. This document is designed to incorporate and coordinate existing pond management practices and policies with newly-applied regulatory requirements.

1.4 CONTEXT FOR THE DEVELOPMENT OF THE POND WATER MANAGEMENT IM/IRA DECISION DOCUMENT

The IM/IRA process and the final remedial actions for OUs 5, 6, and 7 are regulatory- and risk-driven activities, and are normally conducted to address an immediate threat to human health and the environment. No such immediate threat associated with the drainage ponds is known or has been identified.

However, in response to expected changes in the regulatory framework for the drainage ponds, and in response to EPA and CDPHE concerns that management of ponds at the Site was conducted on a "crisis" basis, a Pond Water Management IM/IRA Decision Document was prepared in 1993. The document was quite broad and was intended to establish a framework for pond water management. The document also addressed issues such as the identification and control of the source of contamination, providing for off-channel storage of spills, and methods to control the landfill leachate and other seeps on the site.

To address the numerous questions and conflicting issues pertaining to scope and content raised by the 1993 document, the IAG dispute resolution process was initiated. This process resulted in the development of this second Pond Water Management IM/IRA Decision Document. As discussed earlier, the Resolution of the Senior Executive Committee refined the focus and scope of the current document, and determined how and in what manner the water management concerns of EPA and CDPHE would be addressed.

The objective of this document is to comprehensively review existing pond management approaches and to identify and evaluate a broad spectrum of management alternatives which provide for acceptable operational protocols and administrative and physical controls. Specific objectives guide the evaluation of pond water management and water quality protection:

1. *Ensure discharges from ponds comply with relevant state and federal standards.* The IM/IRA process must consider potential applicable relevant and appropriate requirements (ARARs) for the existing and proposed actions. These requirements define operating criteria for the ponds as well as numeric water quality standards for both transfers among and discharges from the ponds. The evaluation process for identification of these new requirements is documented in Chapter 5, and results in the identification of potential ARARs for pond water management activities.

2. *Minimize the use of Ponds A-1, A-2, B-1, and B-2 for containment and storage of spills.* Presently, Ponds A-1, A-2, B-1, and B-2 are maintained off-line and are available for the emergency containment of spills until other storage or treatment can be arranged. Although these ponds are not routinely used for spill containment, they provide an extra measure of protection for abnormal

situations. The majority of past spills have consisted of small quantities of materials that did not impact any area beyond the immediate spill zone. However, the chromic acid spill of February 1989 (Chromic Acid Investigation Team 1993) resulted in the review of operations and facilities and the creation of an action plan to minimize the likelihood of a similar spill in the future (EG&G 1990; DOE 1989).

Ongoing site environmental upgrade activities, such as those documented in the *Spill Prevention Control Countermeasures and Best Management Practices (SPCC/BMP) Plan* (EG&G 1992), focus on minimizing spill occurrences and improving immediate spill response. Further, additional measures are being taken as part of other Site programs; for example, the construction of tankage for spill control under the IA IM/IRA.

Actions are underway at the Site to reduce the probability of spill occurrence. However, the risk of spills reaching the drainage ponds will never be reduced to zero. Thus, options for alternative management activities and new or modified structures are reviewed in Chapter 6 to determine whether the risk of spills impacting the drainage ponds can be further reduced.

3. *Consider and address the hazardous waste implications of pond water management.* A concern exists that leachate contaminated with a hazardous waste, or leachate classified as a hazardous waste, may enter the drainage ponds. This concern is based on the existence of IHSSs upgradient of nearly every pond. If leachate from IHSSs impacts groundwater or stormwater, the groundwater or stormwater can, in turn, impact the ponds. Consequently, new water management requirements based on hazardous waste ramifications are potentially applicable to management of the drainage ponds and must be identified. The evaluation process for the identification of these new management requirements is documented in Chapters 5 and 7.

While this review identifies concerns over leachate from a hazardous waste unit qualifying as a listed hazardous waste, some contamination sources and remedial actions for these sources are outside the scope of this document. For example, landfill leachate that enters the Landfill Pond from the present landfill could qualify as a hazardous waste. The source of this leachate is directly traceable to OU 7 (the present landfill) and will be addressed by OU 7 activities which are not included in this document. Similarly, contaminated seeps exist on the hillside south of the B-series drainage ponds. Water flowing from these seeps typically evaporates or re-infiltrates into surficial soils prior to reaching the drainage ponds. OU 2 IHSSs have been identified as the source of contamination in this water. Remediation of these contaminated seeps is addressed by OU 2 activities and not in this IM/IRA document.

4. *Address water treatment to meet the applicable state and federal standards identified in 1, above.* The data generally indicate that ambient pond water quality normally meets Big Dry Creek Segment 4 water quality standards. However, it is possible that water quality problems may occur in the future which will make treatment necessary prior to transfer and/or discharge. Moreover, in an industrial setting, where ponds have multiple inflows, both detectable levels of contaminants and occasional exceedances of stringent numeric standards are virtually inevitable. Thus, treatment of pond water may be required if water quality does not meet the quality standards for discharge from the ponds or if ambient pond water quality does not meet water quality standards that apply to the ponds.

   Water treatment systems currently available to treat drainage pond water consist of filtration and granular activated carbon units at terminal Ponds A-4 and C-2. These systems are not capable of treating water for all potential pollutants. Therefore, available methods for water treatment and potential improvements are investigated, as discussed in Chapter 6.

5. *Coordinate actions called for in IM/IRA planning with relevant RFI/RI and CMS/FS activities.* Given that the ponds will ultimately be remediated or eliminated as part of clean-up activities for OUs 5, 6, and 7, interim pond management must be coordinated with RFI/RI (site characterization) and CMS/FS (site remediation) activities.

   It is necessary to reduce the possibility that the IM/IRA, CMS/FS, and RFI/RI activities reach different conclusions. Therefore, the interim management of pond water, as addressed in this document, is based upon the same criteria that govern final remedial actions. This set of criteria is discussed in Chapters 5, 6, and 7 as remediation goals and potential ARARs.

6. *Coordinate pond management activities with future NPDES compliance requirements.* Pond water management must be coordinated with both present and future NPDES activities. It appears that future NPDES activities will consist of two separate areas of compliance. The first area of NPDES compliance will be the WWTP operations and the application of numeric standards to the WWTP discharge. These are expected to be based on the Big Dry Creek Segment 5 water quality standards. Until the new NPDES permit is effective, the terms and conditions of the existing NPDES permit remain in effect. This IM/IRA will only take effect after the new NPDES permit is

issued. The WWTP now discharges to the drainage ponds and, consequently, is a major consideration for this document. The WWTP discharge limitations are not expected to cause water quality problems for the drainage ponds. However, it is not possible to ensure that discharges from the WWTP will comply with applicable NPDES discharge limits all of the time.

The second area of NPDES compliance will be the implementation of stormwater BMPs. Stormwater quality also has a direct influence on pond water quality because stormwater flows generally have high sediment loads which can carry contaminants into the ponds. Even though upstream stormwater is currently routed around some of the ponds, the ponds are still subject to stormwater inflows from the watershed immediately adjacent to those ponds. This watershed includes the industrialized area, IHSSs, and OUs. Chapters 6 and 7 of this document explore additional options for management of stormwater influent to the drainage ponds. Stormwater management activities implemented upstream of the drainage ponds are directly governed by the stormwater NPDES permit, and are outside the scope of this document. However, stormwater management activities are expected to consist of BMPs designed to improve the quality of stormwater.

The stormwater NPDES permit is expected to designate seven specific stormwater monitoring locations and will require the preparation and implementation of a Stormwater Pollution Prevention Plan to control the quality of stormwater runoff from the developed portions of the Site. The activities regulated by these NPDES permits provide important upstream controls on influent water quality, but are otherwise outside the direct scope of this document. However, an integrated approach to pond water management will be implemented that includes water quality and watershed management. Coordination of stormwater controls, RCRA/CERCLA actions, NPDES activities, and pond water management is integral to this approach.

1.5 GOALS AND OBJECTIVES

This document has the following specific goals and associated objectives:

1: Manage water in the most practical and protective way possible, and in a manner which supports final remedial actions.

Given the unpredictability of both weather and event-related contamination, pond water management must address many variables. Operational delays that currently affect the system must be identified and eliminated. These delays include timely data collection, reporting, and application of information to decision-making. In addition, specific allowable actions must be identified for routine and non-routine events (e.g., stormwater runoff), and emergencies (e.g., spills). Finally, it is important to identify interim water management actions which support the long-term goals and activities of final remediation activities.

2: Evaluate the existing administration and management of pond water for the purpose of identifying improvements to, and reasonable monitoring requirements for, the Site pond and surface water system.

This document identifies physical improvements, changes in administrative controls, and reasonable monitoring requirements to improve pond water management strategies.

3: Evaluate the nature, function, operation, and role of the ponds in protecting the biological and physical environment. An aspect of this evaluation includes assessment of the ability of the ponds to meet appropriate regulatory requirements protective of human health and ecosystems.

This document contains an evaluation of the pond system and its role in ensuring water quality and protection of human heath and ecosystems. In particular, attention should be given to continued scientific research of the ponds and related administrative structures which allow for the transmittal of this information to regulators and the public. It is important to assess the ponds from the perspective of engineering, administrative, legal, and ecosystem concerns.

1.6 ORGANIZATION OF THE DOCUMENT

This report is organized into seven major chapters. Chapters 2 and 3 provide a description of the Site, water management practices, and regulatory framework for pond water management. Chapter 4 presents a description of available water quality information and identifies contaminants of concern for the purpose of monitoring pond water quality. These chapters provide a critical evaluation of existing information and present opportunities for improved water management.

Chapter 5 discusses the appropriate regulatory standards applicable to pond water management. Chapter 6 applies these standards and other criteria to the screening and evaluation of several pond water management alternatives. Chapter 6 also identifies new physical controls, management tools, and operational guidelines for the selected interim pond water management alternatives. Chapter 7 presents a framework for the implementation of interim pond water management alternatives, including the monitoring system capabilities required to ensure that the Site discharges achieve applicable standards.

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TABLE 1-1
REGULATORY FRAMEWORK FOR
POND WATER MANAGEMENT AT RFETS

Acronym	Date	Title	Applies to	Chapter
AIP	1989	Agreement in Principle	. Scope of IM/IRA . Roles and Responsibilities	1
NPDES	1972	National Pollutant Discharge Elimination System	. Stormwater BMPs . Monitoring Pond Water Discharge	1,2,4,5
FFCA	1991	Federal Facilities Compliance Agreement	. Pond Water Discharge 1 . Site-Specific ARARs . Monitoring	1,4,5
WQCC	1985	Colorado Water Quality Control Commission	. ARARs . Monitoring	1,4,5
CWA	1972	Clean Water Act	. ARARs . Monitoring	1,5
WQCA	1989	Colorado Water Quality Control Act	. ARARs . Monitoring	1,5
RCRA	1976	Resource Conservation Recovery Act	. Overall Guidance . Pond Water ARARs	1-7
HSWA	1984	Hazardous and Solid Waste Amendments	. ARARs	1-7
CERCLA	1980	Comprehensive Environmental Response, Compensation and Liability Act	. Overall Guidance . Action ARARs	1-7
SARA	1986	Superfund Amendments and Reauthorization Act	. Overall Guidance . ARARs	1-7
Resolution	1994	Resolution of the Senior Executive Committee	. Overall Guidance	1
IAG	1991	Interagency Agreement	. Scope of IM/IRA	1,5,7
Exec Order 11990	1977	Executive Order 11990	. Site ARARs	5
CAA	1973	Clean Air Act	. Site/Action ARARs	5
SDWA	1977	Safe Drinking Water Act	. ARARs	5
ARA	1954	Atomic Energy Act	. Administration	1

TABLE 1-1
(Page 2 of 2)

Acronym	Date	Title	Applies to	Chapter
DOE 5400.5	1990	DOE Order 5400.5	. ARARs . Groundwater	5
ESA	1973	Endangered Species Act	. ARARs . Pond Water Management	2-6
NHPA	1966	National Historic Preservation Act	. ARARs	5
AHPA	1979	Archaeological and Historic Preservation Act	. ARARs	5
FWCA	1934	Fish and Wildlife Coordination Act	. ARARs . Pond Water Management	5
CAQCC	1979	Colorado Air Quality Control Commission (State Implementation Plan, Section 110, Clean Air Act)	. ARARs	5
NEPA	1969	National Environmental Policy Act	. Overall Guidance	1
USACE	1980	Dam Safety Regulations	. Site-Specific ARARs	2,3,5,6,7
MBTA	1988	Migratory Bird Treaty Act	. ARARs	5,6,7
Not Applicable	1940 and Amended in 1972	Eagle Protection Act	. ARARs	5,6,7

901-004\45Acb\Tab1-1

CHAPTER 2

SITE DESCRIPTION AND AFFECTED ENVIRONMENT

This chapter provides background information about the Rocky Flats Environmental Technology Site (the Site) with a focus on those aspects and issues that influence pond water management. The main sections within the chapter discuss the Site, the affected environment, and pond hydrology.

2.1 SITE DESCRIPTION AND AFFECTED ENVIRONMENT

2.1.1 Site Location Map and Facility Description

The Site is owned by the U.S. Department of Energy (DOE) and operated by EG&G Rocky Flats, Inc. (EG&G). The plant's historical mission was the manufacture of nuclear weapons components from radioactive and non-radioactive materials. In January 1992, the decision to halt the production of nuclear weapons components was announced. The Site is currently in transition from a defense production facility to one whose planned future missions include environmental restoration, waste management, including handling special nuclear material, and eventual decontamination and decommissioning (D&D).

The Site covers almost ten square miles, occupying Sections 1 through 4 and 9 through 15 of Township 2 South, Range 70 West, 6th Principal Meridian in Jefferson County, Colorado. The developed plant site, or Industrial Area (IA), comprises roughly 0.65 square miles in the center of the property and is surrounded by a buffer zone of approximately nine square miles (Figure 1-1). The plant is bounded on the north by Boulder County Open Space and privately-owned agricultural land along State Highway 128, on the west by privately-owned land paralleling State Highway 93, on the east by Indiana Street, and on the south by privately-owned agricultural land.

The plant location is sixteen miles northwest of Denver, Colorado and nine to twelve miles from the communities of Boulder, Golden, and Arvada. The communities of Broomfield and Westminster to the east and Superior to the north are the closest population centers to the Site. These communities have grown substantially in the last decade, and Indiana Street represents one of the current boundaries of the City of Broomfield. There are approximately two million people within a 50-mile radius of the Site (Department of Commerce 1992).

2.1.2 Physical Setting

The Site is situated at an elevation of about 6,000 feet on the eastern edge of an essentially flat bench described geologically as an alluvial fan and known locally as Rocky Flats. This bench is approximately five miles wide in an east to west direction. To the east, the topography slopes gradually downward toward the Denver basin at an average grade of 95 feet per mile. Approximately 20 miles to the west, the continental divide rises to elevations exceeding 14,000 feet (EG&G 1990).

2.1.3 Meteorology/Climate

Meteorologic measurements, including precipitation and wind speed, have been made at the Site since 1953. Data collected under this program are primarily used in analysis of airborne emissions, but are also used for surface water management operations. Precipitation data are used to estimate the plant pond inflows. This information, in turn, is factored into the decision-making process for pond releases.

The climate at the Site is characterized by dry, cool winters and warm summers. The average precipitation for the site is 15.4 inches per year (EG&G 1993a) with a range of 7.8 to 24.9 inches based on 24 years of data (1953 to 1976) (Rockwell 1976). Typically, more than 70 percent of the precipitation falls as rain between April and September.

Relative humidity at the Site averages 46 percent, and the annual mean temperature is approximately 50 degrees Fahrenheit. While the average wind velocity is between 8 and 9 miles per hour, wind gusts up to 90 miles per hour have been reported. The number of sunny days averages over 250 annually.

Estimates of yearly evaporation for the Site vary depending on yearly precipitation and pan constants used. According to National Oceanic and Atmospheric Administration (NOAA) data for 1956 to 1970, gross shallow lake evaporation averages 39 inches per year (N0AA 1982). Net evaporation, which takes into account average precipitation, is approximately 28.2 inches per year based on methodology recommended by the State Engineer's Office (SEO) (SEO 1990). Additional detail regarding evaporative losses from the ponds is found in Section 2.2.3.4.

2.1.4 Hydrology

The Site is located within the following four watersheds: Woman Creek, Walnut Creek, Rock Creek, and a small sub-basin associated with an unnamed tributary to Big Dry Creek (Figure 2-1). These drainage basins generally traverse the plant from west to east. Rock Creek flows from the west through the northeast section of the plant site, and is not addressed in this document because it is hydrologically unimpacted by Site operations. Walnut Creek and

Woman Creek are of particular interest to this document because these creeks are hydrologically impacted by plant operations and are intermittent streams tributary to Great Western Reservoir and Standley Lake, respectively. The estimated long-term average annual yields of Walnut Creek and Woman Creek at Indiana Avenue are 34.5 and 32.1 acre-feet, respectively (Advanced Sciences, Inc. [ASI] 1990). These yields are low and the streams are considered to be essentially dry most of the year except during storm events and in the summer months (May through June). Flow in the summer months may reflect irrigation return flows (ASI 1990). Estimated volumes and peak flow rates on Woman and Walnut Creeks associated with the 6-hour storm for runoff events with frequencies ranging from the 2-year to the 100-year event are shown in Table 2-1.

Great Western Reservoir, Standley Lake, and Mower Reservoir are located immediately downstream of the Site. Great Western Reservoir and Standley Lake supply drinking water for the municipalities of Broomfield, Federal Heights, Westminster, Thornton, and Northglenn. Mower Reservoir, which is used for agricultural purposes, is fed by Mower Ditch, which diverts water from Woman Creek on the eastern portion of the plant site. Of these three lakes or reservoirs, Great Western Reservoir is of greatest importance to this document since it was historically fed by Walnut Creek. The majority of the IA drains to Walnut Creek, and the majority of discharges from the Site have historically been made to Walnut Creek.

2.1.5 Hydrogeology

The hydrogeology of the Site area has been studied extensively since the 1970s by the U.S. Geological Survey (USGS), Rockwell International, DOE, and EG&G. Much of the present understanding of the groundwater system is based upon information derived from the over 600 monitoring wells on-site, geophysical studies, and other hydrogeologic information (EG&G 1993; WWE 1993).

The Site is situated on surficial unconsolidated deposits of colluvium and valley fill and Pleistocene alluvium ranging from zero to 100 feet thick. These unconsolidated deposits overlie less permeable bedrock formations of the Denver basin. Surficial deposits consist mainly of the Rocky Flats Alluvium, an alluvial fan deposit which is composed of coarse gravel, coarse sand, and gravelly clay. The valley fill alluvium found immediately surrounding the stream channels consists of fluvial deposits of clay, silt, and sand with gravel lenses. The Fox Hills sandstone, which subcrops in the western portion of the buffer zone, and the Laramie formation underlie the remaining area of the plant. These units consist predominantly of claystone, minor sandstone, siltstone, and coal units. Additional details on site geology can be found in R. T. Hurr's 1976 publication, *Hydrology of a Nuclear Processing Plant Site*, the site-specific Operable Unit (OU) geologic characterization reports, and the 1993 *Draft Well Evaluation Report* (EG&G 1993b).

Groundwater occurs in the surficial materials, typically along the top of less permeable bedrock surfaces, in the weathered bedrock materials, or under perched conditions. Hydraulic conductivity for the unconsolidated surficial deposits (including Rocky Flats Alluvium colluvium and the valley fill alluvium) ranges from 0.3 to 0.003 foot per day (10^{-4} to 10^{-6} cm/sec) with a representative conductivity of roughly 0.17 foot per day (6×10^{-5} cm/sec). Hydraulic conductivities in the valley fill alluvium in Woman and Walnut creeks are generally larger than those in other unconsolidated deposits (EG&G 1993b). These values are much greater than the hydraulic conductivity of the claystone contained in underlying units, which ranges from approximately 0.0003 to 0.00003 foot per day (10^{-6} to 10^{-8} cm/sec) (EG&G 1993b). It is thought that the claystone acts as a relatively impermeable barrier that impedes downward flow of groundwater. This results in a dominantly lateral flow regime to the east, parallel to the drainages. In winter and spring, the alluvium is recharged by precipitation. In the late summer and early fall, the alluvium is generally recharged by seepage from streams, ditches, and ponds. Recharge to the deeper formations most likely occurs as direct precipitation on aquifer outcrops in the western portion of the buffer zone or where streams flow across upturned and exposed formations or along fault traces.

Surface water and groundwater interactions are prevalent at the Site. Bedrock benches often occur near the soil surface so that as groundwater nears the steep sides of the drainages numerous seeps and/or springs form. These seeps and springs occur on steep slopes at considerable distances from any surface water drainage. The amount of groundwater recharging the creeks at the Site is in part related to the topography of the drainage basin. In areas with steep topography, there is potential for significant head differences between surface water and adjacent aquifers. The IA is located on a topographic high, and to the northeast, east, and southeast are North Walnut Creek, South Walnut Creek, and Woman Creek, respectively. Precipitation events also affect groundwater discharge to the Creeks in that water levels in the Rocky Flats alluvium and other unconsolidated deposits fluctuate in response to precipitation patterns (Hurr 1976; EG&G 1994).

Vertical hydraulic gradients in the valley fill alluvium vary throughout the year indicating that water moves from the valley fill alluvium to surface water, or vice versa (EG&G 1993b). Seasonal groundwater potentiometric data from wells in these areas indicates that the hydraulic head of the upper hydrostratigraphic unit is consistently higher than the hydraulic head of the adjacent creeks or valley fill alluvium. During the wet season, the water table is higher, and the resultant hydraulic gradients cause baseflow recharge into the creeks. During drier periods, the water table in the valley fill alluvium is lower. While hydraulic gradients still slope toward the drainages, groundwater does not recharge surface streams in most reaches because the water table in valley fill alluvium is below the channel bottom (EG&G 1993b).

In the upper Woman Creek drainage near the western boundary of the Site, the potentiometric surface in bedrock is near the unconsolidated material/bedrock contact, which is less than 5 feet beneath the creek channel. Groundwater in both the unconsolidated surficial deposits and the bedrock may be in communication with Woman Creek in this area (EG&G 1993b).

2.1.6 Ecology and Sensitive Environments - Wetlands/Floodplains/Threatened and Endangered Species Habitat

A detailed description of the current understanding of existing ecosystems at the Site is presented in Appendix A. Chapter 5 discusses sensitive environments as they relate to regulatory limitations on activities affecting wetlands or threatened and endangered species habitat.

2.1.7 Cultural Resources

Two archaeological surveys of the Site were conducted to comply with requirements of the National Historic Preservation Act of 1966 (36 CFR Part 800) and other federal and state laws governing the management of cultural resources. A total of 51 cultural resources were located in these surveys. These cultural resources were related to the historic Euro-American occupation, except for one isolated artifact affiliated with Native American use of the area. None of the identified cultural resources was recommended as eligible for listing on the National Register of Historic Places. No further work or evaluation or special protection was recommended for these resources (DOE 1991).

2.1.8 Ponds/Drainages/Flowpaths - Description and Maps

In the 40-year history of the Site, 17 water detention ponds have been constructed to serve various purposes. Three of these ponds were constructed in 1955 along Woman Creek but are no longer in existence. Another pond, created in 1974 to impound leachate from the existing landfill, was filled in 1981 to accommodate expansion of the landfill. The remaining 13 ponds are shown on Figure 2-2. Of these 13 ponds, 11 are addressed in this IM/IRA document. These are the A-series ponds (except the small pond on Walnut Creek at Indiana Street [pond W/I] which is used for flow measurements) the B-series ponds, Pond C-2, and to a limited extent, the Landfill Pond. The construction date and current function for each of these ponds is summarized in Table 2-2. Information regarding ponds not included in this report is summarized in Table 2-3.

The four A-series ponds (A-1, A-2, A-3, and A-4) lie northeast of the IA along North Walnut Creek, while the five B-series ponds (B-1, B-2, B-3, B-4, and B-5) lie just east of the IA along South Walnut Creek. The North and South Walnut Creek drainage basins collectively constitute OU 6. There are two ponds in the C-series (Pond C-1 and C-2). Pond C-1 is a flow-through pond located on Woman Creek southeast of the IA. It is not addressed in this document because it does not receive runoff from the IA. Pond C-2 is an off-channel pond which collects stormwater and other flows from the southern portion of the Site via the South

Interceptor Ditch (SID). The portion of the Woman Creek drainage basin within the Site boundaries, including Pond C-2, constitutes OU 5.

As summarized in Table 2-2, the ponds at the Site have several functions. These include containment of surface water runoff, containment of wastewater treatment plant (WWTP) effluent to allow for sample collection and analysis, and emergency spill containment. The ponds are also expected to intercept some groundwater. Figure 2-3 is a routing schematic for the ponds which serves to broadly describe the current disposition, storage, and discharge of water at the Site.

The upper reach of North Walnut Creek collects water from areas west of the IA fence line. This water is currently diverted to the McKay Diversion Structure and is routed north of the Landfill Pond and A-series ponds. The water then converges with the McKay Ditch and is eventually delivered to Walnut Creek downstream of Pond A-4. Runoff in the reach of North Walnut Creek below the diversion structure bypasses Ponds A-1 and A-2 and is collected in Pond A-3 under normal operations.

Woman Creek receives runoff from two areas. These are (1) the area west of the Site from Rocky Flats Lake via Smart Ditch 2, and (2) portions of the southern and eastern buffer zone that includes the old landfill located south of Building 460. Runoff from the southern portion of the IA flows south toward Woman Creek, and is collected by the SID. The SID routes the runoff to Pond C-2.

Several ditches route surface water flows through or around the Site (Figure 2-2). Upper Church and McKay Ditch flows are diverted around the IA and the ponds. Kinnear Ditch, a diversion from Coal Creek, connects to Woman Creek. Smart Ditch 1 runs east from Rocky Flats Lake and empties into Standley Lake. Smart Ditch 2 flows from Smart Ditch 1 toward Woman Creek. Water is no longer actively diverted into Smart Ditch 2, but because of irrigation return flows, Smart Ditch 2 sometimes contains water. Mower Ditch diverts from Woman Creek east of Pond C-2 and supplies Mower Reservoir east of Indiana Street.

2.1.9 Downstream Water Use and Considerations - Option B Projects

In October 1990, DOE agreed to fund an off-site surface water supply project known as Option B to further reduce any risks posed by the Site to downstream water users. The plan includes two primary components: (1) off-site improvements to protect Standley Lake water quality, and (2) replacement of Great Western Reservoir as a drinking water supply for the City of Broomfield by the acquisition of an equivalent water supply (Schmidt 1990). In general, the purpose of Option B is to guard against potential accidental releases and not to serve as a remedial response. Although funding for Option B is provided by DOE, the cities of Westminster and Broomfield are responsible for designing and implementing the project.

Implementation of the Standley Lake portion of Option B is in progress and includes the following major features:

1. A reservoir on Woman Creek east of Indiana Street to capture and store runoff from the Woman Creek watershed and a pipeline and pump station to divert this water to Big Dry Creek; and

2. A pipeline to route Kinnear Ditch water to Standley Lake before it reaches Woman Creek.

As of September 1994, construction on a wetlands mitigation project associated with the reservoir, and route selection for the Kinnear ditch pipeline had begun. Completion dates for the reservoir and pipeline are unknown.

The Great Western Reservoir replacement portion of the Option B project includes:

1. The purchase of raw water for the City of Broomfield;

2. The development of a delivery system from the raw water source to Broomfield;

3. A new water treatment facility for the incoming raw water; and

4. A raw water storage system.

As of September 1994, Item 1 has been completed and Item 2 was under construction. Completion dates for items 3 and 4 are unknown.

2.2 POND SPECIFIC HYDROLOGY

2.2.1 Introduction

Water management on the Site has been designed and is operated with the intent of hydrologically isolating the Site from the surrounding area. This was done by:

1. Constructing the A-, B-, and C-series ponds to capture and detain runoff generated in the IA;

2. Constructing the West Interceptor Ditch and the McKay diversion structure to prevent stormwater runoff generated off-site and west of the IA from entering the drainage ponds; and

3. Constructing the SID to prevent stormwater runoff generated in the IA from entering Woman Creek, and constructing the Woman Creek diversion dam to route Woman Creek around Pond C-2.

The water management facilities described above are shown in Figures 2-2 and 2-3. Pond capacities are presented in Table 2-4.

The A-series ponds (A-1, A-2, A-3, and A-4) are on-channel reservoirs that lie on North Walnut Creek northeast of the IA (Figure 2-2). Ponds A-1 and A-2 are reserved for the purpose of containing potential spills of contaminated material from the Site, and in terms of surface flows, are hydrologically isolated from Ponds A-3, A-4, and most of the North Walnut Creek drainage area. There is a diversion dam immediately upstream of Pond A-1 with a bypass pipe leading to Pond A-3. This diversion dam has a double gate structure to allow water to flow into Pond A-1 or be diverted to Pond A-3. The gate structure above Pond A-1 is normally set so that all stormwater and North Walnut Creek baseflow is diverted around Ponds A-1 and A-2 to Pond A-3. A-3 stores runoff generated from the northern portion of the IA and the undeveloped area (Buffer Zone) immediately north of the IA as well as areas in the Buffer Zone immediately around the ponds. Water is held in Pond A-3 until sufficient volume has accumulated, and then batch released to Pond A-4 using the existing bottom discharge outlet works. Based on data from the *Rocky Flats Drainage and Master Plan* (Master Plan), the total drainage area tributary to Pond A-4 is approximately 332 acres, including 186 acres of the Buffer Zone and 146 acres of the IA (WWE 1992).

The B-series ponds (B-1 through B-5) are on-channel reservoirs that lie on South Walnut Creek just east of the IA (Figure 2-2). Ponds B-1 and B-2 are reserved for the purpose of containing potential spills of contaminated material from the Site and are isolated from surface water flows from Ponds B-3, B-4, and B-5, as well as most of the South Walnut Creek drainage area. A diversion dam immediately above Pond B-1, with a bypass pipe leading to Pond B-4, allows water to flow into Pond B-1 or be diverted to Pond B-4. The gate structure above Pond B-1 is normally set so that all water is diverted around Ponds B-1, B-2, and B-3. Pond B-4 captures and stores runoff from the southern portion of the IA and the Buffer Zone immediately around the ponds.

WWTP effluent from the site is piped directly to Pond B-3. Water is held overnight in Pond B-3 and released daily to Pond B-4 via a manually controlled outlet valve, and subsequently flows through Pond B-4 into Pond B-5, which is the terminal pond of the B-series drainage. The total drainage basin area of Pond B-5 is 268 acres, including 176 acres of IA and 92 acres of the Buffer Zone. In the past, water was discharged from Pond B-5 directly to South Walnut Creek. Starting in September 1990, Pond B-5 has been transferred via pump and pipeline to Pond A-4 in order to consolidate treatment operations at Pond A-4. All water in the A- and B-drainages is currently discharged to Walnut Creek and off-site through Pond A-4.

The SID is located immediately upgradient of Woman Creek and extends from just south of the Building 127 parking lot at the western boundary of the IA to Pond C-2. Runoff from the southern portion of the IA is intercepted by this ditch and conveyed to Pond C-2. The total area that drains to Pond C-2 is estimated at 205 acres, including 171 acres of the Buffer Zone and 34 acres of the IA. A diversion dam on Woman Creek immediately upstream of Pond C-2 routes Woman Creek flows around Pond C-2, such that stormwater runoff from the Buffer Zone within the Woman Creek basin is routed around this pond. Historically, Pond C-2 was released to Woman Creek (and Standley Lake) after sampling and analysis of water quality. Based on an agreement with the City of Westminster, since April of 1990 all discharges from Pond C-2 are pumped cross-basin to the Broomfield Diversion Ditch after sampling and analysis of water quality.

2.2.2 Sources of Inflow to the Ponds

2.2.2.1 Introduction

Water inflows to the ponds are separated into several sources to facilitate quantification of inflow volumes. Inflow sources include:

1. Baseflow from North and South Walnut Creeks;
2. Stormwater runoff;
3. WWTP effluent;
4. Discharges from IM/IRA treatment units associated with the OUs;
5. Groundwater directly influent to the ponds, including springs and seeps;
6. Interpond transfers.

Each source of inflow has varying water quality and volume characteristics. Table 2-5 provides a summary of the sources of inflow to and the outflow destinations for pond water under routine and non-routine operations. Non-routine inflows and outflows represent flow scenarios that either have occurred at the Site on occasion or that could potentially occur based on existing drainage transfer and storage facilities.

Because Ponds A-1 and A-2 and B-1 and B-2 are off-channel they do not require daily management of water volumes. Inflows are limited to direct precipitation, groundwater exfiltration, and localized runoff. Therefore, the majority of the following discussion focuses on water inputs into Ponds A-3 and A-4 and B-3, B-4, and B-5 which manage the significant inflows to the Site.

2.2.2.2 Baseflow

For the purposes of this document, baseflow is defined as that surface water flow which is not attributable to runoff from a specific storm event and that is measured at the upper end of the A- or B-series pond system. Baseflow represents groundwater that "daylights," or is intercepted, by North or South Walnut Creek upgradient from the ponds. Because it represents intercepted groundwater, the magnitude of baseflow varies seasonally in response to fluctuations of the water table. As the water table rises in the early spring in response to precipitation events, the contribution of groundwater to North and South Walnut Creek increases as a larger volume of groundwater is intercepted. For the purpose of estimating baseflow into the ponds, data were evaluated from the gaging stations located at the A-1 and B-1 bypass. Mean daily flows for water year 1993 were plotted and seasonal baseline flows were estimated. The baseline was selected to be the value at which flows consistently returned to after storm events.

Flow into Ponds A-3 and A-4 is measured at gaging station 13 (GS13), which is one of the 13 permanently installed continuous flow meters installed at the site as part of the Event Related Monitoring Program (see Chapter 3). GS13 is located upstream of the A-series Ponds, at the A-1 bypass so that flow measured by the gage is routed around the interior ponds and directed into Pond A-3. Based on the analysis of 1993 data, baseflow ranged from essentially zero during late winter to 0.15 cfs during spring. The annual mean was 0.05 cfs or 11.8 million gallons per year.

Flow into the B-series ponds is measured at GS10, located upstream of the B-series diversion structure. Flows measured at GS10 are diverted around Ponds B-1, B-2 and B-3 and directed into B-4. Estimated baseflows ranged from 0.01 cfs to 0.07 cfs with an annual average of 0.025 cfs or 5.9 million gallons per year. The determination of baseflow using data from GS10 is complicated by bimonthly releases of approximately 9,000 gallons from the OU 2 treatment system. These are also recorded at GS10 and would be included in the flow record.

Major sources of baseflow in the Woman Creek basin include Antelope Springs, irrigation runoff, Smart Ditch inflow from Rocky Flats Lake, and leakage from the South Boulder Diversion Canal. Flow in Woman Creek in the vicinity of the Site is measured at Station GS07 which is located just below Pond C-1. Baseflows at this station were not quantified, however, because Pond C-1 is not addressed in this IM/IRA. The SID which is tributary to Pond C-2 is dry except during periods of storm runoff.

2.2.2.3 Stormwater Runoff

The *Rocky Flats Plant Drainage and Flood Control Master Plan* (Master Plan) analyzed the effects of storm events (return periods between 2 and 100 years) at the Site. The analysis was performed using the Colorado Urban Hydrograph Procedure (CUHP) and the Stormwater

Management Model (SWMM) as required by the Urban Drainage and Flood Control District (UDFCD). Section VII of the Master Plan analyzed flood flows in the IA using HydroCAD to route flood flows through the IA. The peak flow and volume of runoff from the 2-, 5-, 10-, 25-, 50-, and 100-year, 6-hour storms at selected locations is presented in Table 2-6. In addition, because of the developed nature of the IA and its storm drainage system, very small precipitation events (less than as 0.08 inch) are expected to show a runoff response (Squibb 1994).

The *Drain Repair and Improvement Plan Study* (Wright Water Engineers, Inc. 1994) focused on the analysis of identified drainage deficiencies at the Site. A portion of this study examined the effect of large flood flows on the A- and B-series drainage ponds. The starting pond water surface elevations used for this simulation was at the upper end of the normal operating range (see Table 2-4 for operating ranges). For both the A- and B-series ponds, there was adequate capacity to contain the 25-year flood flow, but the 100-year flood flow filled all of the ponds and spilled out of terminal Ponds A-4 and B-5. Pond C-2 would contain the 10-year and 25-year flood flow, but the 100-year event would exceed the safe operating capacity of Pond C-2. Although the ponds were originally designed to contain the 6-hour 100-year flood, improvements to the IA including increased paving, have increased runoff so that the 100-year flood would not be fully contained.

During large storm events, the flow rate in North and South Walnut Creeks exceeds the capacity of the A- and B-series bypass pipes. This will cause flood flows to spill over the diversion structures into Ponds A-1 and B-1. Table 2-6 describes the split flow resulting from large storm events and the limited capacities of the A- and B-series bypass pipelines. This table also shows the flood flow volumes tributary to Pond C-2. Sources of stormwater runoff for Pond C-2 are the SID and overflow of the Woman Creek diversion structure, which only occurs during large events (more than a 25-year, 6-hour storm).

There is some localized stormwater runoff tributary to the A- and B-series ponds that is not measured at the GS13 and GS10 gaging stations. The runoff from precipitation on the basins upstream of the terminal ponds dam crest but downstream of the gaging stations is estimated to be approximately 5 percent of the total storm runoff entering the ponds.

2.2.2.4 WWTP Discharge

The WWTP currently discharges effluent into Pond B-3. The volume of effluent released to Pond B-3 from the WWTP for the period of January 1991 through the present is presented in Table 2-7. Based on this record, the average daily WWTP discharge is approximately 150,000 gallons. The source of this data is the flow meter on the effluent discharge pipe which reportedly overestimates volumes (Squibb 1994). Approximately once per summer, depending on evaporation rates, WWTP discharge is routed to Pond B-1 or B-2 in order to provide sufficient water level in these ponds to cover potentially contaminated sediment. This operation is necessary to prevent airborne transport of silt and dust particles.

2.2.2.5 OU Discharges

Presently two of the OUs on the plant site (OU 1 and OU 2) regularly discharge treated water into the drainages tributary to the ponds. At OU 1, groundwater and infiltrate is collected in a french drain at a rate of approximately 30 gallons per minute; however, the treatment plant is operated on an intermittent basis (Burmeister 1994). Treated effluent is released to two 150,000-gallon effluent storage tanks for testing. The water is then released to the SID intermittently as the tanks fill. In the spring, water is released approximately every two weeks, and during other times of the year, once a month so that the annual discharge is approximated to be 2.3 million gallons. The amount discharged is low small so that, except during periods of spring runoff, effluent infiltrates prior to reaching Pond C-2.

Effluent from the OU 2 treatment unit discharges to South Walnut Creek above the B-series ponds bypass pipe. It discharges a total of 9,000 gallons every two weeks over a 3- to 4-hour period (Vess 1994). This equates to an average yearly discharge of approximately 234,000 gallons. This discharge is released to South Walnut Creek above the South Walnut Creek gaging station (GS10).

The Landfill Pond (OU 7) has little to no impact on the general water balance of the A- and B-series ponds. A recent release of 1.1 million gallons to Pond A-3 occurred in August 1994, in order to allow work on the OU 7 leachate collection project to occur. Approximately once per summer, water from the Landfill Pond may be transferred to Pond A-1 for the purpose of maintaining sufficient pond level so that sediment will remain covered in Pond A-1; however, this water remains in Pond A-1 and is not subsequently released. In response to major storm events, transfers from the Landfill Pond to Pond A-1 have occurred infrequently in order to decrease the water levels in the Landfill Pond.

2.2.2.6 Groundwater

The interaction between shallow groundwater and surface water flows is an important issue in pond water management, since the source of considerable amount of the water managed within the drainage ponds could be groundwater inflows. The dams for the terminal ponds at the Site are constructed with impermeable cores and extend to bedrock. These dams will therefore intercept and retain groundwater moving through the alluvial materials in North and South Walnut Creeks and Woman Creek.

Interactions of surface water and groundwater along the creeks have historically been inferred from informal observations that sections of a creek gain or lose water as the creek traverses the Site. The variation in gaining and losing water properties is most likely transient; that is, it varies during the year and from year-to-year, depending upon the streamflows and position of the water table in the alluvial deposits. More formal stream-reach gain/loss studies along Woman Creek, Mower Ditch, and selected tributaries have been completed as part of OU 5 activities (EG&G 1994). Because these studies are probably indicative of the complexity of the groundwater/surface water interactions along North and South Walnut Creeks, they are briefly discussed below.

These studies involved the installation of over 36 well points along Woman Creek, as well as flow measurement over 20 distinct reaches of the creek. The data indicate groundwater gains and losses to streams at the Site is an exceedingly complex system. Of the 20 reaches defined on Woman Creek, two reaches generally gain water from the shallow groundwater system on a nearly year-round basis. These are the original landfill and old firing range area located southeast of the 903 Pad. One reach appeared to be gaining at all times other than January and February, while another reach was gaining for all periods for which data existed. Nine reaches appeared to be gaining during the winter and spring period (October through May), but were losing during the summer and fall months (July through September). Three reaches appeared to gain for several months or less and then lose the rest of the year. The reach just downstream from Pond C-1 appeared to be gaining into late summer (April through July), but losing the rest of the year. One reach was often dry; however, few data were available for this reach.

Given the variability in gain-loss properties of stream reaches, and the lack of consistent patterns or periods of gain or loss, it is clear that the quantification of the contribution of shallow groundwater to the drainage ponds is an involved and difficult process. However, some generalities can be made regarding the contribution of shallow groundwater to the drainage ponds. The analysis in Section 2.2.2.2 provided an estimated combined baseflow in North and South Walnut Creeks of approximately 0.075 cfs which translates to 17.7 million gallons or 54 acre-feet per year. These baseflows are attributable to shallow groundwater entering the streams upstream of the measurement flumes. Given the small numbers associated with baseflow relative to storm flows, it is a reasonable assumption that the direct shallow groundwater input to the ponds is small.

2.2.3 Sources of Outflow to the Ponds

2.2.3.1 Introduction

Outflow from the ponds at occurs through the following mechanisms:

1. Releases from the terminal ponds to downstream waters;

2. Transfer of water from one pond to another;

3. Evaporation from the pond surface; or

4. Enhanced evaporation of pond water.

Since the ponds are constructed with impermeable cores extending to bedrock, the outflow via seepage through or under the ponds is expected to be negligible compared with other sources of outflow. A summary of the types of outflow associated with each of the ponds is presented in Table 2-4. Each of these outflow mechanisms are discussed below.

2.2.3.2 Releases

Releases can be made to downstream waters from the Terminal Ponds A-4, B-5, and C-2. A-4 releases into North Walnut Creek. B-5 can release to South Walnut Creek but is usually transferred to Pond A-4 where it is batch-sampled prior to release. Pond C-2 can be released off-site via a pipeline to the Broomfield Diversion Ditch or directly to Woman Creek. When possible, releases are made to downstream waters only from Ponds A-4 and C-2. Since April 1990, Pond C-2 has only been discharged through the Broomfield Diversion Ditch. Data are available regarding releases made to downstream waters for the period August 1989 through July 1994. A summary of the data regarding the releases is presented in Table 2-8.

2.2.3.3 Transfers

Transfers are made between various ponds for the purpose of water quality and water supply management. Possible transfer routes are described in Table 2-4 and the most frequently used routes are illustrated in Figure 2-3.

2.2.3.4 Evaporation

Each of the ponds loses water through evaporation from the pond surface. The amount of water lost depends on the surface area, which is a function of the amount of water stored in the pond at any given time. As discussed previously, net evaporation using SEO methodology is estimated at 28.2 inches.

It should be noted that there are vast differences in the results from numerous pan evaporation studies and guidance concerning evaporative loss estimates for this region of Colorado. Sources of evaporative loss estimates include the National Oceanic and Atmospheric Administration's (NOAA's) Technical Report 33, 1982; EPA SW-874, 1983; Kohler, *Evaporation from Pans and Lakes*, 1955; Fiske, *Evaporation from Seven Reservoirs in the Denver Water-Supply System, Central Colorado*, 1977; Koffer, *Investigation of the Surface and Groundwater Flow Mechanics of an Evaporation Spray Field at the Rocky Flats Nuclear Weapons Plant, Jefferson County, Colorado*, 1989 and Advanced Sciences, Inc., *Water Yield and Water Quality Study of Walnut Creek and Woman Creek Watersheds, Rocky Flats Plant Sites*, 1990.

Values for net evaporation from these various sources range from 27 to 46 inches per year, placing the SEO evaporative loss estimates on the low side of the reported range of net evaporative losses. Regardless of the value used, evaporative losses are low relative to off-site discharges or transfers for the ponds that manage WWTP effluent and stormwater. Losses are significant for the interior ponds such that water periodically must be added to keep sediments covered.

2.2.3.5 Spray Evaporation and Spray Irrigation

Spray evaporation was used throughout the 1980s and early 1990s as a method of pond water volume reduction for Ponds A-1, A-2, B-1, B-2, and the Landfill Pond. Water was sprayed above the surface of the pond through the use of fog nozzles. The practice was discontinued in 1993.

Beginning in 1979, WWTP effluent was discharged to Pond B-3 and then piped to various "spray field" locations. Spray irrigation was conducted for the purpose of pond water volume reduction, and was discontinued in March 1990 primarily due to concerns related to hazardous waste issues and management practices.

2.2.4 Summary of Overall Hydrologic Balance

A detailed analysis of pond water management requires quantification of pond inflows and outflows. Such a water balance will assist the evaluation of operational management alternatives in Chapter 6. The flow monitoring network at the Site has been upgraded over the past several years such that a reasonably accurate water balance for the drainage ponds can be established on an annual basis.

Using data collected in 1992 and 1993, inflows and outflows for Ponds A-3, A-4, B-3, B-4, B-5, and C-2 were quantified. In instances where several records or data sets were available for a particular input or output parameter, the data thought to be the most reliable and complete was used. These values are summarized in Tables 2-9 and 2-10 and are shown, along with the generalized water routing scheme, on Figure 2-4. The interior ponds (A-1, A-2, B-1, and B-2) were not included in this analysis because they are isolated from the majority of inflows and are not routinely involved in water transfers or discharges.

The accuracy of the data was evaluated by preparing a water balance. Ideally, inflows minus outflows to the system should equal the change in stored volume to satisfy the basic relationship:

$$\text{Inflow} - \text{Outflow} = \text{Change in Stored Volume}$$
or
$$\text{Inflow} = \text{Outflow} + \text{Change in Stored Volume}$$

In other words, any incoming water not lost via discharge or evaporation would be accounted for as increased stored volume in the ponds.

Inflows to the A-series ponds are stormwater, baseflow, local inflow, and transfers of water from Pond B-5. Stormwater and baseflow are measured by the continuous flow recorder at GS13 located at the A-1 bypass (Figure 2-4). Because there are large gaps in the continuous record where the recorder was inoperative, data for annual flow was calculated using values collected manually approximately every three days. Stormwater flows were quantified by subtracting the annual average baseflow of 11.8 million gallons per year from the total recorded yield. Local inflow refers to the runoff that enters the pond below the flow gage and was estimated using the Soil Conservation Service (SCS) methodology with a curve number of 80, which is representative of runoff from the buffer zone. Data on transfers from B-5 were provided by EG&G personnel and were measured using a flow meter inside the transfer pipe. Total annual inflows to Ponds A-3 and A-4 for 1993 were estimated at 113 million gallons.

Outflows from the A-series ponds are off-site discharges and evaporation. Off-site discharges were obtained from flow records at GS11 located just downstream of Pond A-4. Evaporative losses were computed by applying the annual net evaporation of 28.2 inches to the average monthly surface area of Ponds A-3 and A-4. For 1993, these ponds gained approximately 9.1 million gallons, which was estimated by comparing the beginning of the year volume to the end of the year volume. Therefore, the total outflow and increase in stored volume was estimated to be 116 million gallons. The 3 million gallon discrepancy between outflow and inflow could be attributed to a number of factors including shallow groundwater exfiltration into the ponds and errors associated with the three day observations rather than a continuous record.

Inflows to the B-series ponds are stormwater, baseflow, local inflow, discharges from OU 2, and effluent from the WWTP. Stormwater, baseflow, and OU 2 discharges are measured by the continuous recorder at GS10 (Figure 2-4). Stormwater flows were quantified by subtracting the annual average baseflow of 5.9 million gallons a year estimated from the total annual yield at GS10. Annual OU 2 flows are estimated at 0.2 million gallons and are accounted for at GS10. WWTP flows are measured with an in-pipe flow meter and data were provided by EG&G. Local runoff was calculated similar to the A-series. Total 1993 inflows were estimated at 73 million gallons.

Outflows from the B-series ponds are transfers to Pond A-4 and evaporation. Transfer flow rates are measured with an in-pipe flow meter. Multiple sources have indicated that the flow values obtained with the in-line meter are inaccurate and tend to overestimate transfer volumes up to 40 percent. For this reason, the transfer value reported on Table 2-9 was calculated based on more reliable data sources such as inflow into Pond B-5 as measured at GS09 (Figure 2-4) and non-transfer outflows. Evaporative losses were calculated using the same methodology as the A-series ponds. Changes in stored volume were estimated by comparing the beginning of the year volume to the end of year volume. In 1993, Ponds B-3, B-4, and B-5 gained approximately 2.1 million gallons. Therefore, the total losses and increases in stored volume were estimated at 78 million gallons. The 5 million gallon discrepancy between outflow and inflow, as with the A-series ponds, could be attributed to shallow groundwater exfiltration into the ponds and/or periods in which GS10 was inoperative. In particular, the largest storm of 1993 occurred on June 17 and 18; this event washed out GS10 and thus a key storm event was not recorded (Squibb 1994).

Data for Pond C-2 is limited (Table 2-10). No permanent continuous flow meter has been installed upgradient of the pond to accurately quantify inflows from the SID. Data for 1992 flows were available as reported in the *Stormwater NPDES Permit-Application Monitoring Program* (EG&G 1993c). The report presented flows for SW027, which is a 66-inch corrugated metal pipe (CMP) located at the Woman Creek bypass canal (Figure 2-4). Daily flow measurements, with approximately one month of missing values, were published for October 1991 through December 1992. This data yielded an annual estimated inflow to Pond C-2 of 32.2 million gallons for 1992. OU 1 discharges approximately 2.3 million gallons a year of treated water into the SID. However, the majority of the water infiltrates into the SID prior to reaching Pond C-2. Pond C-2 showed decreases in volume during 1992 of 3.9 million gallons. Total annual inflows and decrease in stored volume estimated at 36.3 million gallons.

Outflow from Pond C-2 is measured via an in-line flow meter on the discharge pipe to the Broomfield Diversion Ditch. The reported 1992 discharges were 16.1 million gallons. This discharge combined with evaporation yield a total outflow of 18.6 million gallons. The large discrepancy between inflow and outflow is attributed to the inaccuracy associated with the SW027 gage. The flow measurements are based on a stage-discharge curve developed for the CMP. The curve is based on Manning's equation with an estimated roughness coefficient. While the relationship is thought to provide reasonable values during high flows, considerable error is associated with the low flow measurements that make up the majority of the record (Wetherbee 1994).

The relative contribution of each component of inflow and outflow to the drainage ponds is graphically represented in Figures 2-5, 2-6, and 2-7. The largest component of inflow to the A-series Ponds is transfers from Pond B-5 which comprise 65 percent of total inflow. The B-series ponds are dominated by the WWTP which makes up close to 79 percent of the total annual inflow. Evaporative losses are relatively small for all of the ponds.

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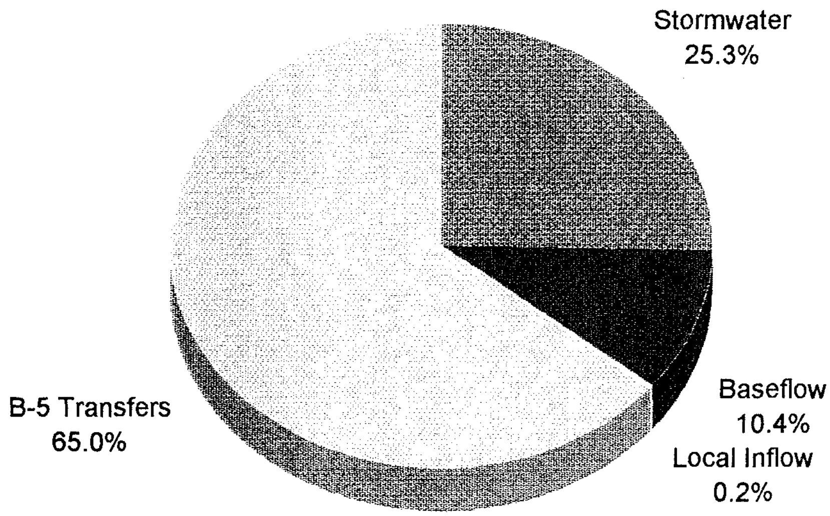
FIGURE 2-5: 1993 WATER BALANCE FOR A-SERIES PONDS

Inflows to Ponds A-3 & A-4
Total Volume = 112.99 Mgal

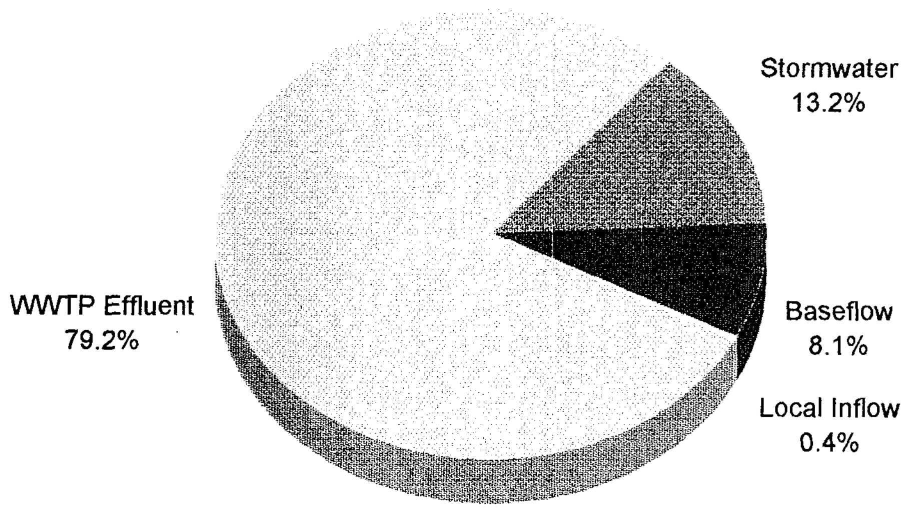


Outflows, Losses & Stored Volume Increases
from Ponds A-3 & A-4
Total Volume = 115.84 Mgal

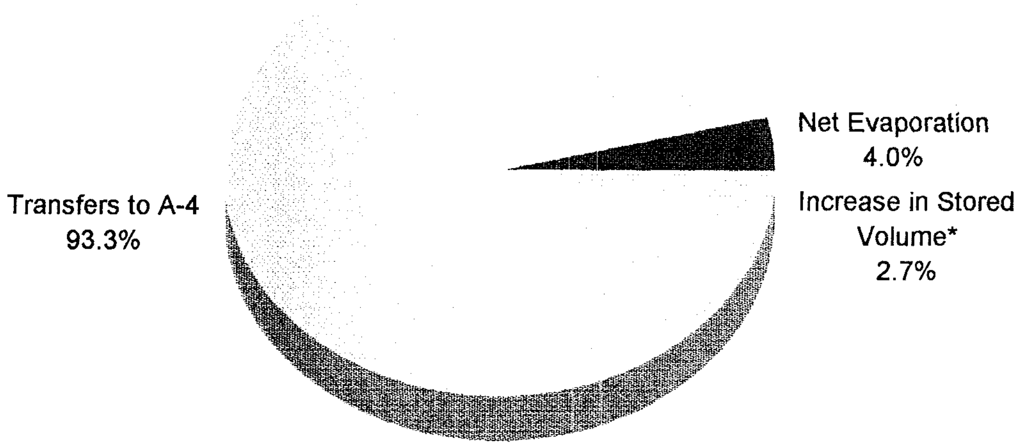
*When total inflows exceed the sum of total outflows and losses from the ponds, there is a net increase in the volume of water stored in the ponds.

FIGURE 2-6: 1993 WATER BALANCE FOR B-SERIES PONDS

Inflows to Ponds B-3, B-4 & B-5
Total Volume = 73.02 Mgal



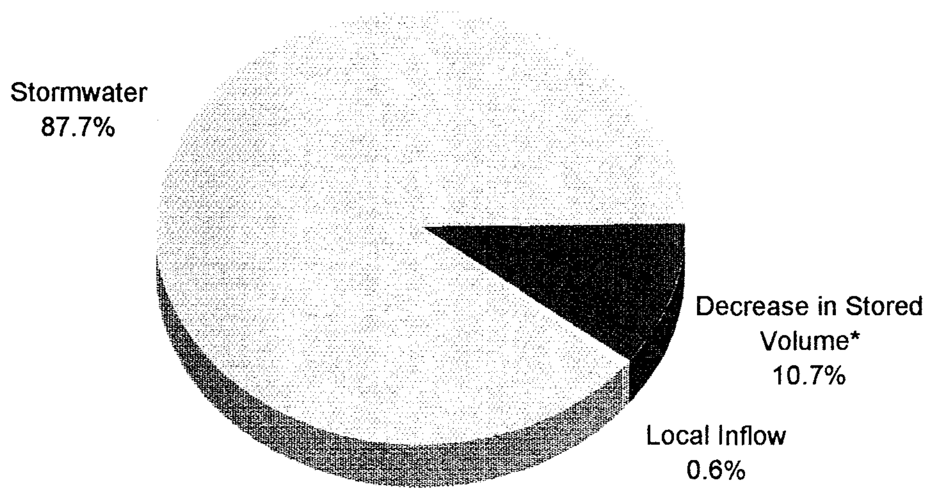
Outflows, Losses & Stored Volume Increases from Ponds B-3, B-4, & B-5
Total Volume = 77.51 Mgal



*When total inflows exceed the sum of total outflows and losses from the ponds, there is a net increase in the volume of water stored in the ponds.

FIGURE 2-7: 1992 WATER BALANCE FOR POND C-2

Inflows & Stored Volume Decreases from Pond C-2
Total Volume = 36.31 Mgal



*When total inflows are less than the sum of total outflows and losses from the ponds, there is a net decrease in the volume of water stored in the ponds.

Outflows & Losses from Pond C-2
Total Volume = 18.55 Mgal

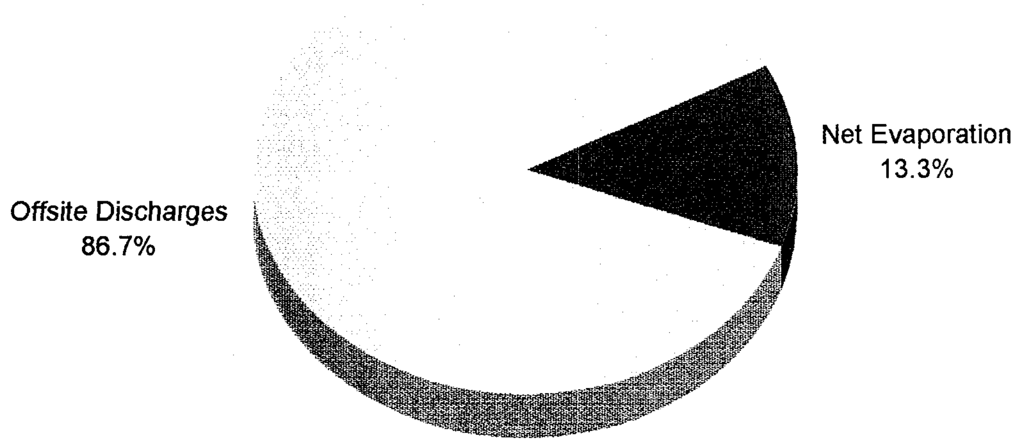


TABLE 2-1
PEAK FLOW AND RUNOFF VOLUME AT SELECTED LOCATIONS[1]
PRESENT DEVELOPMENT CONDITIONS
(6-Hour Storm)

Location	Area (acres)	2-Year Event		5-Year Event		10-Year Event		25-Year Event		50-Year Event		100-Year Event	
		cfs	af	cfs	af	cfs	af	cfs	af	cfs	af	cfs	af
STANDLEY LAKE BASIN													
Woman Creek Basin at SBDC[2]	570	0	0	0	0	0	0	0	0	31	6	130	21
Woman Creek at Pond C-2 Bypass	1,414	10	1	62	7	130	22	320	52	460	77	690	116
Inflow to Pond C-2	205	6	2	39	6	77	10	150	18	190	22	250	28
Woman Creek at Indiana Street	2,880	29	9	150	30	370	78	830	162	1,100	221	1,600	301
Upper Big Dry Creek Basin at SBDC	1,261	32	10	130	30	250	53	440	84	580	109	800	144
Upper Big Dry Creek at Indiana Street	2,995	27	12	240	68	530	135	970	277	1,300	291	1,700	377
GREAT WESTERN RESERVOIR BASIN													
Walnut Creek Basin at SBDC	154	0	0	0	0	0	0	0	0	6	2	23	6
Walnut Creek Basin at Walnut Creek Diversion Dam	486	51	5	74	7	90	8	130	12	170	19	240	31
McKay Diversion Canal at Outlet	550	28	5	42	7	54	8	78	12	120	20	210	33
Inflow to Pond A-4[3]	332	14	1	48	4	72	7	122	11	150	21	184	30
Inflow to Pond B-5[3]	268	90	15	118	20	143	27	217	34	270	40	330	48
Walnut Creek at Indiana Street	2,374	210	42	480	78	800	118	1,400	183	1,800	232	2,300	296
ROCK CREEK BASIN													
Rock Creek Basin at SBDC	224	0	0	0	0	0	0	0	0	33	2	99	8
Rock Creek at Highway 128	1,862	68	19	94	24	270	60	660	122	890	163	1,200	215

[1]The values listed are the peak flow and volume of runoff occurring at the downstream end of the Surface Water Management Model (SWMM) element.
[2]SBDC = South Boulder Diversion Canal
[3]Assumes upstream ponds at beginning of simulation are at upper end of normal operating range
Source: Modified from WWE 1992.
901-004\45Acb\Chapters\Tab2-1

TABLE 2-2
DRAINAGE PONDS ADDRESSED IN THE POND MANAGEMENT IM/IRA

Pond	Date Constructed	Type	Purpose	Destination of Surface Water
A-1 and A-2 (North Walnut Creek)	A-1: January, 1954 A-2: 1973	Non-discharge	Provide emergency capacity for diversion of suspect water within North Walnut Creek. Can also receive water transfer from Landfill Pond via pump and pipeline. A-2 can also receive water from B-2 via pump and pipeline.	A-1 water is transferred to A-2 by pumping or by direct spillway discharge, depending on volume. A-2 spillway overflows will go to Pond A-3.
A-3 (North Walnut Creek)	1974	Discharge	Impounds surface water from North Walnut Creek and runoff from the northern plant site area. Receive water through A-1 Bypass pipe.	Discharges to A-4.
A-4 (North Walnut Creek)	1979	Discharge/ Terminal Pond	Serves as the point of discharge for all surface waters collected from North Walnut Creek and South Walnut Creek. Receives water pumped from B-5 and direct discharges from A-3.	Discharges to North Walnut Creek on an intermittent basis. Timing of release depends on volume of stormwater runoff, WWTP inflow, and current storage levels at A-3, A-4, and B-5.
B-1 and B-2 (South Walnut Creek)	B-1: November, 1962 B-2: July, 1953	Non-discharge	Provide emergency spill capacity from central portion of the core area by diverting South Walnut Creek and/or Central Avenue ditch flows to B-1. B-1 and B-2 can also receive WWTP effluent if quality is unsuitable for discharge.	B-1 overflows into B-2. B-2 can discharge via pump to A-2. B-2 spillway overflows will go to Pond B-3.
B-3 (South Walnut Creek)	July, 1953	Discharge	Receives and impounds treated sanitary effluent from WWTP.	Releases to B-4 on a daily basis during daylight hours only.
B-4 (South Walnut Creek)	Prior to July 1953	Controlled Flow-through	Receives surface water runoff from South Walnut Creek via the B-1 Bypass pipe and daily releases of WWTP effluent from Pond B-3.	Flows through directly to B-5, no operational holding capacity.
B-5 (South Walnut Creek)	1979	Discharge/ Terminal Pond	Terminal pond for B-series.	Can discharge directly to South Walnut Creek. Currently (since 8/90) B-5 water is transferred to A-4 via pump and pipeline.

TABLE 2-2

Pond	Date Constructed	Type	Purpose	Destination of Surface Water
C-2 (Woman Creek)	1979	Discharge/ Terminal Pond	Receives and impounds surface water runoff from southern portion of developed plant site via South Interceptor Ditch. Serves as point of discharge.	Discharge via pump and pipeline to the Broomfield Diversion Ditch. Capabilities also exist to transfer C-2 water via pump and pipeline to B-5 and/or A-4, or to discharge directly to Woman Creek (under the NPDES permit).
Landfill Pond (East Landfill Pond)	1974	Non-discharge	Impounds landfill leachate. Intercepts groundwater.	Previously spray evaporated to North and South spray fields. Currently discharged to Pond A-3.

TABLE 2-3
DRAINAGE PONDS NOT ADDRESSED IN THE POND MANAGEMENT IM/IRA[1]

Pond	Date Constructed	Approximate Location	Type	Original Purpose	Current Purpose	Destination of Surface Water
C1	March, 1955	Woman Creek upstream of Pond C-2	Flow through	Temporary holding of Woman Creek water and waters discharged from Ponds 6, 7, and 8.	Temporary detention pond for Woman Creek flow.	Woman Creek
West Landfill Pond	1974	Adjacent to the present landfill	Non-discharge	Impoundment for leachate generated by landfill.	N/A - West Landfill Pond was buried in 1981 to allow eastward expansion of the landfill.	Spray Evaporation/Land Application
Pond 6	Between January and March, 1955	Adjacent to Woman Creek, upstream from Pond C1	Flow through	Received water treatment plant backwash.	N/A - not in existence	Woman Creek
Pond 7	March, 1955	Adjacent to Woman Creek, upstream from Pond C1	Flow through	Received steam condensate from Building 881 cooling towers and possibly sewage lift station overflows.	N/A - not in existence	Woman Creek
Pond 8	March, 1955	Adjacent to Woman Creek, upstream from Pond C1	Flow through	Retention pond for cooling tower overflow/blowdown from Building 881 outfall.	N/A - not in existence	Woman Creek
Pond A-5 (Retention Pond at Walnut and Indiana)	1978	Walnut Creek immediately upstream of Indiana St.	Flow through	Flow measurement of Walnut Creek using 2 Parshall Flumes.	Flow measurement at Walnut Creek.	Walnut Creek

[1]Ponds that were built primarily for waste management, rather than surface water management, are not addressed in this table or document (i.e. Solar Ponds). The West Landfill Pond is included in this table since it was built in a natural surface water drainage.

TABLE 2-4
POND CAPACITIES AND OPERATIONAL SPECIFICATIONS

Pond	Elevation (feet)	Capacity (million gallons)	Capacity (acre feet)	Percent of Capacity Full
Pond A-1				
Spillway Elevation	5829.1	1.40	4.30	100%
Action Level[1]	5828.6	1.24	3.81	88.6%
Normal Operational Range	5827.3 5825.9	0.84 0.42	2.58 1.29	60% 30%
Pond A-2				
Spillway Elevation	5816.9	6.03	18.51	100%
Action Level[1]	5815.9	5.21	15.99	86.4%
Normal Operational Range	5813.7 5810.4	3.62 1.81	11.11 5.56	60% 30%
Pond A-3				
Spillway Elevation	5793.0	12.4	38.06	100%
Normal Operational Range	5792.2 5781.5	11.16 1.2	34.25 3.68	90% 10%
Pond A-4				
Spillway Elevation	5757.9	32.5	99.75	100%
Action Level[1,2]	5756.9	29.8	91.45	91.7%
Normal Operational Range	5753.3 5741.0	21.1 3.3	64.76 10.13	65% 10%
Pond B-1				
Spillway Elevation	5882.0	0.53	1.63	100%
Action Level[1]	5881.5	0.43	1.32	81.1%
Normal Operational Range	5878.5 5877.5	0.33 0.17	1.01 0.52	60% 30%
Pond B-2				
Spillway Elevation	5868.9	1.56	4.79	100%
Action Level[1]	5867.9	1.25	3.84	80.1%
Normal Operational Range	5866.8 5864.6	0.94 0.47	2.88 1.44	60% 30%

TABLE 2-4
(Page 2 of 2)

Pond	Elevation (feet)	Capacity (million gallons)	Capacity (acre feet)	Percent of Capacity Full
Pond B-3				
Spillway Elevation	5851.7	0.57	1.75	100%
Normal Operational Range	5849.7	0.260	0.80	45%
Pond B-4 (flow-through)				
Spillway Elevation	5835.8	0.18	0.06	100%
Normal Operation	5835.8	0.18	0.06	100%
Pond B-5				
Spillway Elevation	5803.9	24.0	73.66	100%
Action Level[1,2]	5802.9	22.9	70.33	95.4%
Normal Operational Range	5796.5 5785.8	12.0 2.4	36.83 7.37	50% 10%
Landfill Pond				
Spillway Elevation	5921.0	7.52	23.08	100%
Action Level[1]	5920.0	6.65	20.41	88.4%
Normal Operational Range	5917.0 5912.5	4.51 2.26	13.84 6.94	60% 30%
Pond C-2				
Maximum Elevation	5765.3	22.8	69.98	100%
Action Level[1,2]	5764.3	20.0	61.38	87.7%
Normal Operational Range	5760.3 5753.5	14.8 2.3	45.5 7.06	65% 10%
Total Capacity (excluding Pond B-4)		109.31	335.51	

[1]Action Level is defined as 1 foot below spillway elevation, except for Ponds A-1 and B-1 which are ½ foot below spillway elevation.
[2]For terminal Ponds A-4, B-5, and C-2, a series of action levels are specified corresponding to various pond levels. See Section 3.2.3.3.

TABLE 2-5
INFLOW AND OUTFLOW TO ROCKY FLATS DRAINAGE PONDS

Pond	Normal Operation		Possible Operation	
	Inflow Source	Outflow Destination	Inflow Source	Outflow Destination
A-1	. Direct Precipitation . Groundwater . Local Basin Runoff	. Evaporation	. Runoff from Plant Site for purpose of spill control . North Walnut Creek . Large storms that exceed A-1 bypass capacity . Landfill Pond transfers	. Treatment and downstream release . Pumped transfer to Pond A-2 . Overflow to Pond A-2
A-2	. Direct Precipitation . Groundwater . Local Basin Runoff	. Evaporation	. Pumped transfer from B-1 . Pumped transfer from B-2 . Overflow from Pond A-1 . Pumped transfer from Pond A-1 . Landfill Pond transfers	. Treatment and downstream release . Enhanced evaporation . Overflow to Pond A-3
A-3	. Runoff from Plant Site . Direct Precipitation . Groundwater . Local Basin Runoff . Base Flow	. Evaporation . Transfer to Pond A-4	. Overflow from Pond A-2 . Landfill Pond transfers	. Overflow to Pond A-4 . Piped discharge to Walnut Creek (with or without treatment)
A-4	. Transfer from Pond A-3 . Direct Precipitation . Groundwater . Local Basin Runoff . Transfers from Pond B-5	. Evaporation . Release to North Walnut Creek	. Same as normal operations . Transfers from Pond C-2	. Same as normal operations . Continual release to Walnut Creek . Treatment prior to release to Walnut Creek
B-1	. Direct Precipitation . Groundwater/Seeps . Lower Basin Runoff	. Evaporation	. Runoff from Plant Site for purpose of spill control . North Walnut Creek . Large storms that exceed B-1 bypass capacity . WWTP (upset condition)	. Treatment and downstream release . Pumped transfer to Pond A-2 . Pumped transfer to Pond B-2
B-2	. Direct Precipitation . Groundwater/Seeps . Local Basin Runoff	. Evaporation	. WWTP (upset condition) . Pumped transfer from B-1	. Treatment and downstream release . Pumped transfer to Pond A-2 . Overflow to Pond B-3
B-3	. Direct Precipitation . Groundwater/Seeps . Local Basin Runoff . WWTP	. Evaporation . Daytime release to Pond B-4	. Overflow from Pond B-2	

Pond	Normal Operation		Possible Operation	
	Inflow Source	Outflow Destination	Inflow Source	Outflow Destination
B-4	. Direct Precipitation . Groundwater/Seeps . Local Basin Runoff . Releases from Pond B-3 . Runoff from Plant Site . Discharge from OU 2 . Base Flow	. Evaporation . Overflow to Pond B-5	. WWTP (Bypass of B-3)	
B-5	. Direct Precipitation . Groundwater . Local Basin Runoff . Releases from Pond B-4 (Stormwater and WWTP)	. Evaporation . Pumped transfer to Pond A-4	. WWTP (Bypass of B-3) . Transfer from Pond C-2	. Release to South Walnut Creek
C-1	. Woman Creek . Direct Precipitation . Groundwater . Local Basin Runoff	. Woman Creek		
C-2	. South Interceptor Ditch . Direct Precipitation . Groundwater . Local Basin Runoff . Discharge from OU 1	. Off-site discharge via pipeline to Broomfield Diversion Ditch	. Overflow from Woman Creek	. Pumped transfer to Pond A-4 . Pumped transfer to Pond B-5 . Treatment and release via pipeline to Broomfield Diversion Ditch . Direct release to Woman Creek
Land-fill Pond	. Direct Precipitation . Groundwater . Local Basin Runoff	. Evaporation	. Same as normal operation	. Pumped transfer to Pond A-1 . Pumped transfer to Pond A-2 . Pumped transfer to Pond A-3 . Overflow to drainage gulch

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TABLE 2-6
FLOOD FLOW RUNOFF
VOLUME IN ACRE-FEET

6-Hour Storm Frequency (Return Period in Years)	A-Series Ponds [1]				B-Series Ponds [2]				Pond C-2[3]		
	Volume Arriving at A-Bypass (ac-ft)	Peak Flow Rate (cfs)	Volume through Bypass Pipe (ac-ft)	Volume to Pond A-1 (ac-ft)	Volume Arriving at B-Bypass (ac-ft)	Peak Flow Rate (cfs)	Volume through Bypass Pipe (ac-ft)	Volume to Pond B-1 (ac-ft)	Inflow from SID (ac-ft)	Additional Inflows (from WCBC Overtop) (ac-ft)	Flood Flows in WCBC (cfs)
2	9.7	109.8	8.2	1.5	14.2	93.0	14.2	0.0	2	0.0	10
5	14.6	198.0	9.6	5.0	18.3	112.6	17.6	0.7	6	0.0	62
10	21.8	281.8	11.3	10.5	24.7	122.0	22.3	2.3	10	0.0	130
25	31.6	427.3	12.3	19.3	30.1	133.5	25.7	4.4	18	1.3	320
100	52.0	611.5	14.3	37.8	40.8	222.8	31.2	9.6	28	26.4	690

[1]Capacity of A-series bypass pipeline is 67 cfs. Capacity includes head build-up to top of diversion structure.
[2]Capacity of B-series bypass pipeline is 99 cfs. Capacity includes head build-up to top of diversion structure.
[3]Capacity of Woman Creek Bypass Canal is 230 cfs.

TABLE 2-7
WWTP DISCHARGE

Month	Discharge (Millions of Gallons)			
	1991	1992	1993	1994
January	6.23	4.06	4.65	7.48
February	4.96	3.60	4.40	4.15
March	5.92	5.02	5.06	5.80
April	6.0	3.98	6.15	4.57
May	6.25	4.08	4.82	3.92
June	5.06	4.29	4.78	2.68
July	3.74	3.48	3.93	2.87
August	3.42	4.60	3.98	3.32
September	2.86	3.75	4.27	
October	3.24	3.97	2.68	
November	3.29	4.36	6.14	
December	3.36	5.20	5.27	
Total	54.33	51.76	57.13	

Source: EG&G Building 995 Operations Staff.

TABLE 2-8
RELEASES TO DOWNSTREAM WATERS
AUGUST 1989 THROUGH JUNE 1994

Dates of Release		Terminal Pond	Volume of Release	Comments
Begin	End			
08/17/89	09/30/89	B-5	18.4	Treated water
08/26/89	09/21/89	A-4	11.4	Simultaneous B-5 release of treated water
09/27/89	10/17/89	A-4	7.7	Simultaneous B-5 release of treated water and A-3 transfer (amount unknown)
10/04/89	10/06/89	C-2	1.6	Release to Woman Creek
10/12/89	10/21/89	C-2	9.8	Release to Woman Creek
03/24/90	05/21/90	B-5	29.7	Treated water
03/29/90	05/29/90	A-4	42.4	Simultaneous B-5 release of treated water and A-3 transfer (22.84)
04/16/90	05/25/90	C-2	20.1	Release via pipeline to Broomfield Diversion Ditch
06/05/90	06/08/90	C-2	2.1	Release via pipeline to Broomfield Diversion Ditch
08/02/90	08/30/90	A-4	14.6	Simultaneous B-5 release of treated water and A-3 transfer (3.4)
08/02/90	08/30/90	B-5	14.5	Last routine B-5 release
09/14/90	10/14/90	A-4	9.1	Simultaneous B-5 transfer (11.56)
10/24/90	11/30/90	A-4	9.0	Simultaneous B-5 transfer (9.03) and A-3 transfer (8.30)
01/24/91	01/28/91	A-4	1.1	
02/01/91	04/12/91	A-4	28.4	Simultaneous B-5 transfer (16.86) and A-3 transfer (4.12)
04/19/91	07/06/91	A-4	69.0	Simultaneous B-5 transfer (49.35) and A-3 transfer (21.19)
06/06/91	06/24/91	C-2	10.8	Release via pipeline to Broomfield Diversion Ditch
09/06/91	09/16/91	A-4	9.9	
10/25/91	10/31/91	A-4	8.0	
12/07/91	12/18/91	A-4	13.4	
12/20/91	01/10/92	A-4	24.5	Simultaneous B-5 transfer (13.84) and A-3 transfer (10.60)

TABLE 2-8
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Dates of Release		Terminal Pond	Volume of Release	Comments
Begin	End			
02/15/92	02/21/92	A-4	5.3	
03/14/92	04/05/92	A-4	55.5	Simultaneous B-5 transfer (20.62) and A-3 transfer (34.31)
03/24/92	04/07/92	C-2	16.1	Release via pipeline to Broomfield Diversion Ditch
04/10/92	04/16/92	A-4	6.3	
05/23/92	06/05/92	A-4	17.0	
07/11/92	07/24/92	A-4	16.3	
09/05/92	09/21/92	A-4	27.8	Simultaneous B-5 transfer (10.41)
10/20/92	10/28/92	A-4	8.9	
12/12/92	12/24/92	A-4	24.1	Simultaneous B-5 transfer (13.03)
02/13/93	02/26/93	A-4	11.9	
03/27/93	04/28/93	A-4	54.0	Simultaneous B-5 transfer (25.14) and A-3 transfer (16.73)
04/21/93	04/30/93	C-2	5.8	Release via pipeline to Broomfield Diversion Ditch
06/15/93	06/22/93	A-4	7.6	
07/23/93	08/11/93	A-4	25.2	Simultaneous B-5 transfer (13.34)
11/10/93	11/24/93	A-4	21.1	Simultaneous B-5 transfer (11.37)
01/08/94	01/24/94	A-4	19.6	Simultaneous B-5 transfer (11.65)

TABLE 2-9
1993 ANNUAL WATER BALANCE FOR PONDS A-3 & A-4 AND PONDS B-3, B-4, AND B-5
(Volumes in Millions of Gallons)

Inflows	Volume	Data Source	Outflows	Volume	Data Source
A-Series Ponds					
Stormwater	28.6	Annual yield recorded at GS13 less the estimated baseflow	Off-site Discharges	101.7	Annual yield measured at GS11
Baseflow	11.8	Estimated from mean daily flow records at GS13	Net Evaporation	5.1	Based on net evaporation applied to average monthly surface area of ponds
Local Inflow	0.3	Estimated using SCS methodology	Increase in Stored Volume	9.1	Difference between end of year and beginning of year volume
B-5 Tranfers	72.3	Calculated based on (annual yield GS09+ inflow) - (evap. + storage)			
TOTAL	113		TOTAL	116	

Inflows	Volume	Data Source	Outflows	Volume	Data Source
B-Series Ponds					
Stormwater	9.6	Annual yield recorded at GS10 less the estimated baseflow	Transfers to A-4	72.3	Calculated based on (annual yield GS09+ inflow) - (evap. + storage)
Baseflow	5.9	Estimated from mean daily flow records at GS10	Net Evaporation	3.1	Based on net evaparation applied to average monthly surface area of ponds
Local Inflow	0.3	Estimated using SCS methodology	Increase in Stored Volume	2.1	Difference between end of year and beginning of year volume
WWTP Effluent	57.1	Data provided by EG&G Building 995 personnel			
TOTAL	73			78	

TABLE 2-10
1992 ANNUAL WATER BALANCE FOR POND C-2
(Volumes in Millions of Gallons)

Inflows	Volume	Data Source	Outflows	Volume	Data Source
Stormwater	32.2	Annual yield measured at SW027 (EG&G 1993c)	Off-site Discharges	16.1	Provided by EG&G personnel
Local Inflow	0.2	Estimated using SCS methodology	Net Evaporation	2.5	Based on net evaporation rate applied to average monthly surface area of ponds
Decrease in Stored Volume	3.9	Difference between end of year and beginning of year of volume			
TOTAL	**36.3**		**TOTAL**	**18.6**	

CHAPTER 3

CURRENT POND WATER MANAGEMENT STRATEGY AND OPERATIONAL PRACTICES

Water management activities at Rocky Flats Environmental Technology Site (the Site) include an integrated set of physical controls, administrative plans and programs, and monitoring activities applied to incoming water sources, ambient pond water, and discharges. Monitoring programs and information management demonstrate the effectiveness of the water management system and its ability to meet relevant discharge standards. This chapter describes current water management practices and associated programs as they pertain to Ponds A-1 through A-4 on North Walnut Creek, Ponds B-1 through B-5 on South Walnut Creek, Pond C-2 adjacent to Woman Creek, and the South Interceptor Ditch (SID) which feeds Pond C-2. In order to be protective of the sitewide regional environmental and discharge water quality, the Site has implemented numerous programs for the prevention of spills, minimization of volumes and toxicity of waste, stormwater pollution control, groundwater monitoring, and sitewide watershed management practices.

Operations and organizations at the Site are changed from time to time in order to better address and resolve concerns related to water management. The ability to adjust to new conditions is an advantage in the overall management of the system in that it enables the Site to respond to specific events and new information or requirements. Consequently, this chapter focuses more on the functions of water management, rather than on a particular water management organization.

3.1 MANAGEMENT OF INCOMING WATER SOURCES

Management of upstream water flows and quality is accomplished through the use of administrative tools, physical controls, spill prevention and response activities, information management, and coordination. These programs and controls are described below.

3.1.1 Administrative Plans and Programs

Administrative plans, programs, and procedures are used to manage influent water and contaminants. These administrative tools comply with the laws, regulations, and guidance documents described in Chapters 1, 2, and 5. The content of individual control plans as they relate to surface water management are described below and shown in Table 3-1.

3.1.1.1 *Spill Prevention Control Countermeasures and Best Management Practices (SPCC/BMP) Plan*

The original SPCC/BMP Plan for the Site was prepared in November 1981. This plan was updated in March 1985 and September 1992, and is scheduled for triennial revision in September 1995. The SPCC portion of the plan defines procedures and design criteria for primary containment, spill prevention, and response to spills. The best management practices (BMPs) portion of the plan addresses prevention of water pollution from sources ancillary to the industrial manufacturing process. BMPs are broad and include procedures for good housekeeping, preventive maintenance, or physical construction efforts such as sediment and erosion control practices. Major activities associated with spills and spill management are shown in Table 3-2.

The Site has a material management philosophy for spill prevention and control which aims to protect both human health and the environment through the use of multiple levels of protection. The first level involves spill prevention and BMPs, where possible, including appropriate design of facilities, waste minimization and hazardous chemical substitution programs, material handling procedures, and systems integrity assurance programs. These activities and programs serve to prevent the occurrence of releases and to minimize their impact if they do occur. The second level involves employee training, awareness, and safety/procedural programs. The third level of protection involves the careful review of the circumstances surrounding those spills and releases that do occur in order to identify spill prevention and management practices that need revision.

In the event of a spill, early control and response are achieved by spill containment measures, employee ability to recognize an event and follow response procedures, a structured emergency response plan, and a highly trained and fully equipped Hazardous Materials (HazMat) Team. In the unlikely event that a spill goes undetected or is of too great a volume to be handled by standard HazMat Team methods, spill control is handled by the engineered surface water control system that includes ditches from which flow can be blocked or diverted, and contingent spill control ponds. The spill control ponds are only used in the event that the spill cannot be controlled at an upstream location and would probably migrate to stormwater ponds or off-site locations. Appropriate use of the ditches and spill control ponds can prevent the off-site release of spills and can also allow response personnel to take appropriate remedial actions for the treatment or mitigation of the spill.

EG&G Surface Water staff are responsible for developing, coordinating, maintaining, and updating the SPCC/BMP Plan. To complete these tasks, Surface Water personnel use the resources and expertise of other groups, particularly those groups with responsibilities relating to spill prevention and control.

3.1.1.2 *Stormwater Pollution Prevention Plan*

The draft *Stormwater Pollution Prevention Plan* (SPPP) (DOE 1994) was prepared in support of the National Pollutant Discharge Elimination System (NPDES) permit application and will be a defined requirement of the new permit when issued. The SPPP describes a number of activities designed to minimize pollution and is a multi-faceted plan which includes both existing and proposed activities affecting materials handling at the plant site.

The overall approach of the SPPP is to organize a sitewide Stormwater Pollution Prevention Team representing departments within the Site. This assures that all aspects of plant operations are considered in developing strategies and programs for stormwater pollution prevention. The purpose of the SPPP is to integrate the information regarding sources of and pathways for contaminants with existing and proposed new alternative BMPs and implementation measures for stormwater pollution prevention and control.

3.1.1.3 *Oil Pollution Prevention Plan*

A draft *Oil Pollution Prevention Plan* (OPPP) for the Site (EG&G 1994a) has been submitted to the U.S. Environmental Protection Agency (EPA) Regional Administrator. The OPPP incorporates many of the provisions of the SPCC/BMP and SPPP, but targets specifically the storage of petroleum products. The draft OPPP describes oil storage facilities and associated containment structures and delineates response and reporting requirements for petroleum-related spills or releases.

3.1.1.4 *Waste Minimization Program Plan*

The waste minimization program is part of the general material inventory system which tracks the identity, quantity, and location of hazardous chemicals and solid wastes throughout the plant site. The goal of the *Waste Minimization Program Plan* (WMPP) is to minimize the volume and toxicity of waste generated at the Site through chemical substitution, recycling, use restrictions, and other methods.

3.1.1.5 *Groundwater Protection and Monitoring Program Plan*

Because of the natural connections between the groundwater and surface water at the Site, it is possible for spills to impact groundwater, and therefore protection of groundwater resources is a legitimate concern in response to spills and other releases. The first *Groundwater Protection and Monitoring Program Plan* (GPMPP) was prepared in 1991 and was updated and reissued in 1992 and 1993. The GPMPP addresses the overall groundwater management program. The intent of the GPMPP is to conduct and coordinate groundwater testing and monitoring activities as well as to define the technical and regulatory requirements for those activities. The GPMPP also provides for the integration of groundwater management activities with other ongoing environmental programs at the Site, particularly the surface water management activities (EG&G 1993a).

3.1.1.6 *Integrated Watershed Management Plan*

The *Integrated Watershed Management Plan* (IWMP) was completed in April 1993 (EG&G 1993b). The IWMP established guidelines and BMPs for management of resources within the three watersheds at the Site. Establishing appropriate guidelines allows maintenance and environmental restoration activities to continue while ensuring the protection of natural resources. The IWMP includes methods for weed control, vegetation stabilization, erosion control, pesticide management, and watershed monitoring throughout the plant site and the Buffer Zone.

3.1.1.7 Other Interim Measures/Interim Remedial Action Decision Documents

The existing Interim Measures/Interim Remedial Action (IM/IRA) Decision Documents for Operable Units (OUs) 1 and 2, and the pending Industrial Area (IA) IM/IRA Decision Document identify administrative plans and programs for water management within their respective operations areas. These documents also specify the monitoring and reporting requirements for water leaving OUs 1, 2, and the IA (DOE 1990; DOE 1992a; EG&G 1994b).

3.1.1.8 *Work Plan for Control of Radionuclide Levels in Water Discharges from the Rocky Flats Plant*

Finalized in January 1992 (DOE 1992b), this work plan was prepared in response to Section XII of the Statement of Work to the Interagency Agreement (IAG). The work plan describes sampling methods, analytical protocol, methods, and limitations for determining radionuclide levels, summarizes statistical assessments of accumulated analytical results, and presents recommendations for additional radionuclide studies to better characterize the water quality of the Site discharges. Also described are current approaches for planning, approving, and conducting off-site discharges of water from the Site terminal ponds (A-4, B-5, and C-2). Approaches for implementing discharge are reviewed, and methods for streamlining operations are proposed. Current treatment approaches and limitations are reviewed and plans for future treatability studies are addressed.

3.1.2 Physical Controls

Existing physical controls used to manage influent water sources and potential contaminants include a combination of containment, diversion, and treatment facilities (Table 3-3). Some physical controls, such as secondary containment berms around tanks and equipment, and the wastewater treatment plant (WWTP) equalization basins, are designed to provide continuous routine control functions without the need for human involvement. Other physical controls are used only in emergencies and require action to be taken by operations or response personnel. Individual physical control measures are described below, and are shown in Figure 3-1.

3.1.2.1 WWTP Equalization Basins

Two 60,000-gallon equalization basins upstream of the WWTP headworks are available to isolate and detain potential spills or slugs of contaminants that enter the sanitary sewer. These basins can be operated independently or together and provide a detention time of approximately 20 hours. These basins are used primarily to improve the efficiency of the WWTP by dampening peak flow rates, but also serve to protect the WWTP from elevated concentrations of contaminants that could cause upsets of the biological processes (activated sludge) used at the WWTP.

3.1.2.2 WWTP

The WWTP is an activated sludge facility which uses primary and secondary clarification, aeration, filtration, and chlorination processes, and additional processes for dechlorination and tertiary clarification for phosphorus removal. Activated sludge treatment plants such as the Site WWTP are effective in removing low concentrations of metals, organics, radionuclides, and conventional pollutants. The WWTP provides primary physical control over the majority of wastewaters generated at the Site which reach the pond system.

3.1.2.3 Ponds A-1, A-2, B-1, and B-2 and Associated Bypass Diversion Gates

These ponds are maintained off-channel during normal flow conditions and do not receive water flows unless bypass gates are closed or flood conditions exceed bypass pipe capacities. Gated outlet works do not exist for these ponds, thus no inadvertent outflow can occur, other than from overflow conditions. The arrangement of these ponds is such that overflow of A-1 is automatically captured by Pond A-2, and overflow of Pond B-1 is automatically captured by Pond B-2. In addition, a transfer pipeline from Pond B-2 to Pond A-2 is available to alleviate potential overflow conditions at Pond B-2. Manually operated slide gates (valves A1-2, A1-3, B1-1A, and B1-1B on Figure 3.1) are in place at the entrances to the 48-inch diameter A-1 and B-1 bypass pipes. These gates are locked open during normal flow, allowing North and South Walnut Creeks to bypass Ponds A-1/A-2 and B-1/B-2, respectively.

3.1.2.4 Secondary Containment Structures

Concrete containment berms exist around all aboveground process waste tanks. Concrete or compacted and lined earth berms exist around all aboveground fuel storage tanks.

3.1.2.5 Solar Ponds Interceptor Trench Gallery (OU 4 IM/IRA)

A series of trenches north of the Solar Ponds (OU 4) intercept contaminated seepage and groundwater which would otherwise impact the groundwater regime of North Walnut Creek and the A-series ponds. Intercepted water is pumped to OU 4 treatment facilities or Building 374 where water is evaporated, condensed, and recycled (DOE 1992c).

3.1.2.6 Process Wastewater System

Water used in production operations, decontamination and cleaning operations, analytical laboratories, medical facilities, or any other chemical process facility is, and has always been, handled by a closed loop, independent wastewater system. This system does not discharge untreated water to the environment or to the sanitary sewer system leading to the WWTP. The major components of this system are double-walled process waste transfer pipes, large process waste storage tanks, and a waste system evaporator located in Building 374. This evaporator condenses aqueous waste streams to waste sludges and yields clean "product water" effluent which is used in cooling towers or discharged to the WWTP via the sanitary sewer. Evaporator product water is an identified internal waste stream within the draft NPDES permit, and has specific effluent limitations and monitoring requirements.

3.1.2.7 WWTP Effluent Storage Tanks

Approximately 500,000 gallons of standby tankage for storage of WWTP effluent are planned for installation as part of the IA IM/IRA Decision Document. No schedule for design and construction of this facility has been set yet. When constructed, these tanks will provide out-of-pond capabilities to store suspect waters leaving the WWTP, thereby minimizing the use of Ponds B-1 and B-2 for upset control and significantly reducing the potential for upsets to reach downstream stormwater Ponds B-5 and A-4.

3.1.3 Influent Water Quality/Quantity Monitoring

A number of interrelated programs at the Site, including some of those discussed under administrative controls, conduct extensive monitoring of water quality upstream of the ponds. In general, these monitoring programs are driven by a particular regulatory requirement and thus aim to answer a specific technical and/or regulatory question. Monitoring data is routinely evaluated and interpreted by individuals responsible for pond water management, and is used to assess the potential for contamination to reach the ponds. The details of the various influent monitoring programs are summarized below.

3.1.3.1 Stormwater Monitoring

Three programs, summarized in Table 3-4, currently exist or are planned for monitoring stormwater flows and quality. These are discussed below.

1. Event-Related Runoff Monitoring Program

   The purpose of this program is to collect, interpret, and disseminate available data on surface water hydrology and stormwater quality. The program began in late 1990 with the installation of 13 gaging stations (EG&G 1993c). Additional stations have been added since that time so that as of August 1994, 21 gaging stations are operational (shown in Figure 4-2 and designated by "GS"). Of the 21 stations, only GS01 to GS13 are intended to be long-term stations for the monitoring of water quality and flow. The remaining stations are associated with OUs or other short-term projects and will be eliminated when they are no longer needed. The stations include hardware to monitor water levels continuously and collect water quality samples with increases in stream stage.

   This network is currently administered by the U.S. Geological Survey through an interagency agreement with the U.S. Department of Energy (DOE), and data collection is coordinated by the EG&G Surface Water group (EG&G 1993c). Frequency of monitoring under the event-related program and analytes monitored are summarized in Table 3-4.

2. NPDES Storm Water Monitoring

   The revised NPDES permit is expected to regulate surface water discharges from six locations (shown in Figure 4-2 and designated by "SW") and footing drain discharges to the stormwater drainage system. The draft permit dated February 1994 (EPA 1994) requires that existing BMPs affecting stormwater runoff quality continue to be implemented until they are modified or replaced by the SPPP. The draft permit requires that the SPPP be implemented within six months of EPA approval. Additionally, the draft permit requires that a plan for monitoring footing drain discharges to the stormwater drainage system be submitted within six months of the effective date of the permit and implemented within three months after approval.

   To assess the effectiveness of the SPPP, the February 1994 draft permit requires self monitoring in the terminal ponds (Ponds A-4, B-5, and C-2) promptly after storm events for the analytes listed in Table 3-4. Monitoring is required at least once per quarter during the second, third, and fourth calendar quarters each year following a rainfall event of 0.5 inches or greater.

3. IA IM/IRA Stormwater Monitoring

Water exiting the IA is proposed to be monitored using automated sampling instruments at the discharge locations specified in the IA IM/IRA Decision Document (EG&G 1994b). These stations will collect water samples that will be analyzed for the current NPDES/Federal Facilities Compliance Agreement (FFCA) analyte list as well as other potential analytes that could be released from decommission and decontamination (D&D) activities. Samples will be collected when predetermined increases in stream stage are measured or when surface flow is detected in typically dry drainages.

Sample locations included in the IA IM/IRA monitoring program are identical to stormwater outfalls identified in the draft NPDES permit, and consist of stations SW022, SW023, SW027, SW093, SW118, and SW998 (Figure 4-2).

3.1.3.2 Existing WWTP Effluent Monitoring

Existing effluent monitoring of the WWTP is driven by the current NPDES permit as modified by the NPDES-FFCA and is summarized in Table 3-5. The FFCA targeted specific parameters that are of particular concern due to recent problems or events, and incorporated these specific parameters into the list of analytes for which routine monitoring is now required under the NPDES program.

3.1.3.3 Future WWTP Influent and Effluent Monitoring

Under the revised renewal NPDES permit, influent water sources are regulated at the point of entry to the sanitary sewer, as are discharges at the outfall of the WWTP. The draft permit requires that WWTP effluent meet effluent limitations for the constituents listed in Table 3-6.

The draft permit also requires monitoring for spills and chemical compounds that could cause operational problems at the WWTP and/or result in the discharge of excessive amounts of pollutants. The permit requires that internal waste streams, which include non-stormwater discharges to the sanitary sewer, meet certain effluent limitations and monitoring requirements listed in Tables 3-6, 3-7, and 3-8. Additionally, the draft permit requires that the spill control measures outlined in the *Chromic Acid Incident Plan* continue to be implemented, and that a real-time alpha radioactivity monitor be installed on the WWTP discharge.

3.1.3.4 Operable Unit Discharges Monitoring

The discharge of treated water to drainages at the Site is currently taking place from OUs 1 and 2 under their respective IM/IRAs. The source of water treated at OU 1 is groundwater and infiltrate, while the source of water at OU 2 is seepage flow. The OU 1 system discharges into the SID after sampling and analysis. The OU 2 system discharges to South Walnut Creek upstream of the B-1 Bypass and is measured at gaging station GS10. The OU 2 effluent is monitored while water is being treated (approximately once every two weeks). Analytes and effluent limitations for these IM/IRAs are summarized in Tables 3-9 and 3-10.

3.1.3.5 Groundwater Monitoring

Groundwater monitoring at the Site was initiated in 1954 and has developed over the years to a present network of 455 active wells and piezometers. The wells are distributed throughout the Site in order to satisfy regulatory requirements and to assist in characterization efforts being performed as part of OU Remedial Investigation/Resource Conservation Recovery Act (RCRA) Facility Investigation (RI/RFI) work plans. Groundwater samples are collected quarterly from selected alluvial and bedrock wells. The *Annual RCRA Groundwater Monitoring Report for Regulated Units at RFP* (EG&G 1993d), the GPMPP, and the *Annual Environmental Monitoring Reports for RFP* provide further information on this program.

3.1.3.6 Real-Time Monitoring

The current real-time flow monitoring network consists of 13 remote surface water monitoring locations. Eight stations (GS03, GS07, GS09, GS10, GS11, GS13, GS14, and GS18) currently monitor flows within the Walnut and Woman Creek drainages upstream and downstream of the ponds, with an additional flow monitoring station (GS01) on Smart Ditch where it leaves the site in the extreme southeast corner of the property (Figure 4-2). Continuous pond level monitors are installed at Ponds A-3, A-4, B-5, and C-2. Four rain gages are also monitored–one at the 61-meter meteorological tower on the west side of the Site, one just east of the WWTP, one located east of Pond B-5, and one located west of Pond C-2. In September 1994, a number of dam piezometers were added to the network, and are currently being calibrated (Table 3-11).

Currently, real-time water quality monitoring capabilities exist only at Ponds A-4, B-5, and C-2. At each location, water quality parameters (conductivity, pH, salinity, temperature, dissolved oxygen, and redox potential) are monitored using a Hydrolab® H_2O multiprobe meter. Turbidity is also monitored using a Hach® surface scatter turbidimeter.

In addition to installed instrumentation, each station consists of battery packs and/or solar cells for local power needs, distributed process controllers for receiving and executing commands, and transmitters for communicating with the central network computer. Communications are accomplished using radio telemetry technology through a series of repeater towers. Each station is programmed for automated reporting to the central network computer, where data is automatically archived for future retrieval. The system features bi-directional control of remote sites using Supervisor Control and Data Acquisition techniques, a graphical computer interface for viewing current information as it is generated at any site, and has "GOES" satellite transmitter capabilities.

This system was designed to be expandable and there are significant future plans for network expansion and system optimization. Identified future development activities (budget dependent) include new flow monitoring stations, rain gages and groundwater level monitors, water quality monitoring improvements using specialized water quality meters, and upgrades to the communications network and graphical user interface to optimize system performance.

3.2 MANAGEMENT OF DISCHARGES AND RETAINED VOLUMES

Management of discharges and retained water volumes is guided by two competing concerns: (1) a current commitment to hold water and conduct appropriate sampling so as to assure that releases which do occur meet the conditions and requirements for water quality represented by stream standards, and (2) water retention and discharge practices which maintain acceptable dam safety.

3.2.1 Dam Safety and Pond Volume Management

Maintenance of dam safety and pond volume management are integral and interrelated components of pond operations. Operational specifications related to pond volume management are provided in Table 2-4. Rationale for the operational specifications are described below.

3.2.1.1 Dam Safety

The U.S. Army Corps of Engineers (USACE) conducted engineering analyses of the embankment dams at Ponds A-4, B-5, and C-2 during 1990 and 1991, and finalized their report in early 1993 (USACE 1993). The USACE identified potential dam stability problems under the new (i.e., current) operational practices and calculated a series of safety factors for each of these dams under assumed loading conditions. Safety factors were under 1.5 (a typical design value) for all conditions at all ponds, and ranged from .94 (Pond B-5) to 1.25 (Pond A-4) under various partial pool conditions. The USACE analyses indicated safety factors significantly lower than expected or otherwise indicated by historic operations. For Ponds A-4 and C-2, where pool elevations greater than 90 percent have been successfully managed for short periods, the USACE report showed safety factors near or below 1.0 (e.g., imminent failure) at maximum (100 percent) capacity and safety factors below 1.3 for pond levels above 20 percent. The USACE recommended lowering routine pond levels and adding instrumentation (e.g., piezometers) to monitor internal dam conditions.

Because the USACE analyses did not clearly specify "safe" pond levels, EG&G Plant Civil Engineering prepared an "Evaluation of USACE Draft-Final Stability Analysis of Dams A-4, B-5, and C-2" (EG&G 1993g). The significant result of this analysis was the recommendation that the USACE piezometer level recommendations and drawdown limitations should be incorporated into the Emergency Preparedness Implementation Plan (EPIP) action plan for dam safety. These recommendations classify dam conditions into seven action levels based on pond level and crest and toe piezometer levels. The recommended action plan is shown in Figure 3-2. Current flow and pond level surveillances and frequencies are shown in Table 3-11.

A third study of the dams (and additional piezometer and inclinometer installations) was conducted by Woodward-Clyde in 1994. The draft report for this study (EG&G 1994e) recommends a continuation of the maximum drawdown rate of one foot per day for dams A-4, B-5, and C-2. The document also states that no immediate modifications to the dams are recommended as long as historic operating conditions over the last few years continue. The historic operating conditions for the period January 1, 1992 to July 31, 1994 are discussed in Chapter 2.

It is important to note that "maximum" safe holding capacities currently specified for the dams and cited throughout this document are assumed values. These values, which are 65 percent, 50 percent, and 65 percent for dams A-4, B-5, and C-2, respectively, are based on "best engineering judgment" of the available information. Relying solely on the USACE report would indicate safe holding capacities well below 50 percent at all ponds, while historic performance (e.g., lack of visible structural problems) would indicate values in the 80 percent to 90 percent range.

3.2.1.2 Stormwater Pond Volume Management

Terminal Ponds A-4, B-5, and C-2 were originally designed to handle stormwater flows and volumes from the IA resulting from the 100-year, 6-hour storm event. The current NPDES permit specifies that the permanent pools for these ponds shall be maintained at or below 10 percent, leaving the remaining 90 percent available for short-term (e.g., 72-hour) stormwater detention (EPA 1984). This 10 percent requirement has not been achieved on a routine basis since 1989. Instead, average pond levels are between 20 and 30 percent, and levels routinely exceed 50 percent for extended periods.

Operational specifications for the stormwater pond volumes are for the most part based on the dam safety considerations described in the previous section. Operational decisions regarding water transfers and discharges are also based on seasonal rainfall/runoff predictions, storm events in progress, and expected batch discharge cycle times. Discharges and transfers occur using a combination of pumping facilities and valved outlet works.

3.2.1.3 Non-Discharge Ponds Volume Management

Ponds A-1, A-2, B-1, and B-2 are small earthen detention dams that are structurally stable at full volume. Since dam safety is not a concern for these ponds, volume management operations focus on balancing the following two competing requirements:

1. Maintain the maximum storage capacity possible to capture and retain potential spills and upsets, and

2. Maintain enough water in these ponds to stabilize potentially contaminated sediments and prevent airborne remobilization of contaminants.

Generally, a minimum volume of 10 percent is necessary to cover pond sediments. For Pond A-2 only, a minimum pool volume of 30 percent is desired in order to maintain the thriving aquatic habitat in this pond, including a significant bass population. Ponds A-1, B-1, and B-2 do not support significant aquatic life, and are allowed to fall below 30 percent via natural evaporation. All transfers and spray evaporation (for Pond A-2) are discontinued when pond levels fall below 30 percent. To keep sediments wet, both Pond A-1 and Pond B-1 received water transfers in August 1994 when pond levels fell below 10 percent.

3.2.2 Water Quality Information Management for Inflows, Retained Volumes, and Discharges

Management of water quality information is a key element of overall water management and is an administrative function whose goal is to provide timely transmittal of analytical results for the purpose of characterization, reporting, or operational decision-making. The Site has maintained a central database for water quality information, called the Rocky Flats Environmental Database System, or RFEDS, since 1989. All analytical results for sampling efforts conducted by the various environmental programs are entered into the RFEDS system. Requests for analytical services and management of analytical results are coordinated through the EG&G Sample Management Office (SMO) (Analytical Services Division). Generally, the SMO decides which laboratory to send a sample to, arranges for data validation services, receives validated analytical results, and transmits data packages to users and the Data Management Division for entry into RFEDS. According to SMO personnel, approximately 95 percent of all environmental samples go to off-site laboratories, although a majority of surface water samples are analyzed at on-site laboratories due to operational time constraints.

As a result of the volume of information generated by the various sampling programs at the Site, the number of participating laboratories, and the lag time for entering analytical results into the system or retrieving information from the system, individual organizations generally maintain and manage water quality information for their respective programs in parallel databases to support current program needs. All off-site laboratories are required to deliver data in electronic format to speed entry of this data into RFEDS; however, off-site laboratories generally have longer turnaround times. Planned improvements in data management to allow analytical results from on-site laboratories to be electronically transmitted directly to RFEDS are in progress, and should be completed in late 1994.

RFEDS allows pond management/operations personnel to access historic water quality information on upstream sampling programs not under their direct control, such as the groundwater monitoring program, OU treatment system discharges, and seep monitoring programs. Current water quality information on upstream water sources can be obtained in a more timely manner by a request to the generating organization. Current information is generally over 30 days old due to laboratory turn-around time, data validation, and data package preparation. Unless special arrangements are made, analyte-specific results (e.g., plutonium) are not released by the analytical laboratories until the entire data package is validated and prepared. Once the data package is ready, the information is transmitted concurrently to the requesting organization and to RFEDS.

Water quality information is maintained and managed by Surface Water personnel for in-pond, pre-discharge, storm event-related, and NPDES-required monitoring programs. Sampling to support these programs is performed by subcontractors under the direction of Surface Water personnel. Most samples used for operational and reporting purposes are routed to the on-site EPA-certified laboratories; however, pesticide samples for pre-discharge and discharge, quarterly whole effluent toxicity (WET) tests, and storm event-related samples go to off-site laboratories.

Standard analytical turn-around time for off-site laboratories is 30 to 60 days for general chemistry, and approximately 75 to 90 days for radionuclides. Expedited pre-discharge analytical testing is completed by on-site laboratories in approximately 14 days, of which the radionuclide portion of the analytical suite is the most time-consuming (about 14 days). Results are reported as preliminary (validated) data since preparation of the formal data package has not been done. Data package preparation is a time-consuming task that can take up to 30 days, or longer if radionuclides are involved.

In addition to water quality information generated and maintained by Site personnel, Colorado Department of Public Health and Environment (CDPHE) and EPA also maintain separate water quality records. Much of these data are in the form of reports generated by the Site to comply with reporting requirements under the Interagency Agreement (IAG) or NPDES permit; however, CDPHE in particular conducts independent sampling. Specific to pond water management, CDPHE takes "splits" of pre-discharge samples and conducts independent water analyses using their own laboratory. CDPHE also takes weekly grab samples of discharged water, monthly in-pond samples from Pond C-2, and quarterly in-pond samples from Ponds B-5 and C-2. These samples are split with EG&G. In addition to the above, the CDPHE Radiation Protection Division takes monthly grab samples for radionuclides, which are composited quarterly from various water bodies at the Site. These samples are not split with Site personnel. CDPHE makes the analytical results from their independent sampling available to Site personnel and the general public at monthly data exchange meetings.

As a result of different analytical methods, variability in laboratory quality control, and imposed standards at or near detection limits, it is a relatively common occurrence that one laboratory will show an exceedance when the other laboratory does not. This analytical variability has caused numerous operational delays due to disagreements between CDPHE and Site personnel over the actual water quality of pond discharges. The correct value to enter into the water quality database, to use for operational decision-making, and to report in required water quality summaries, is a data management problem between CDPHE and the Site which remains unresolved.

3.2.3 Decision-Making and Operational Protocols

Coordination of activities associated with current pond water management operations are most appropriately described in terms of the decision-making process and the corresponding administrative and physical actions which take place. Pond water management as currently practiced, is essentially an event-driven activity. Management decisions are made in response to defined or predicted events such as storm events or spills, and are guided by knowledge or prediction of flow rate, pond volume, and associated water quality. Furthermore, each event can be categorized as routine, non-routine, or emergency, for which distinctly different protocols and procedures apply. Thus, pond water management is a dynamic process which must adapt quickly to changing conditions.

The current approach to pond water management involves three distinct activities:

1. Collection of information;

2. Decisions for appropriate actions; and

3. Implementation of the actions.

Each of these activities requires a significant amount of coordination among various individuals and organizations, only some of which are directly involved in the decision-making process. Administratively, the Surface Water staff of the Environmental Protection management organization of EG&G has overall direct responsibility for managing the activities described above. Operationally, each of the activities requires input from a broad range of internal and external parties. Supporting organizations and coordination efforts between these organizations and the Surface Water staff for each of the three activities are described below.

3.2.3.1 Collection of Information

Information collection is currently conducted in response to three primary operational needs: (1) move clean water through the system and discharge this water downstream in the fastest and most economical way possible; (2) maintain the integrity and functionality of the dams; and (3) capture and isolate contaminated water before it has a chance to migrate and/or contaminate larger volumes. To support these needs, Surface Water personnel regularly collect information on precipitation, streamflows, pond volumes, and WWTP discharges, regularly inspect dam faces and take piezometer readings, collect routine water quality information to look for undesirable trends in the data, and maintain a 24-hour-a-day call list for receiving notification of potential spill events or WWTP upsets.

Precipitation and streamflow information is received and recorded electronically via the Surface Water telemetry network. Weather forecasts are received daily from the meteorological station at the Site. Daily records of WWTP discharges are provided by the WWTP operators (Regulated Waste Operations). Pond levels and additional streamflow measurements are taken by Surface Water field personnel a minimum of once per week. Piezometer readings and visual dam inspections are also conducted once per week, with more frequent dam monitoring conducted at higher pond levels according to existing emergency procedures.

Actual or potential spills or upsets are considered non-routine events and are immediately reported to the Site Shift Superintendent, a 24-hour-a-day manned position, who notifies response personnel, including the on-call Surface Water representative. If warranted, the Shift Superintendent activates the Emergency Operations Center (EOC) and notifies state and federal authorities. Shift Superintendent notification and possible EOC activation also may occur in response to heavy precipitation events which trigger higher action levels of the dam emergency response plan. On-call Surface Water personnel are management and senior operations staff who are familiar with the layout of the Site drainage system and can direct the blocking of drainage ditches at strategic locations, direct the placement of containment booms based on the location of the event, or can determine which diversion gates (A-1 or B-1) need to be closed. Existing protocols require special sampling to be conducted at affected or potentially affected stream locations and ponds to expeditiously confirm or deny the presence of contaminants. Maps of the Site showing drainage pathways, culvert locations, and outfalls are kept in the EOC.

Under the current operational mode for the ponds, which involves batch transfer of Ponds A-3 and B-5 to Pond A-4, and batch discharge of Ponds A-4 and C-2, routine water quality information collected on influent water streams by the various monitoring programs is not used for pond management operational decision-making. As discussed previously, analytical turnaround times are such that it is impossible to detect low level water contamination within a time period that would allow diversion and capture of these flows. However, real-time analytical methods capable of detecting slugs (e.g., high concentrations) of contaminants are being investigated by Surface Water personnel. These methods are more fully discussed in Chapters 6 and 7.

In preparation for routine transfer and discharge operations, Ponds A-3 and B-5 are field-tested for pH and nitrate, and visually inspected for algae blooms or high turbidity to give an indication of gross water quality. Once transfers are completed, Pond A-4 is sampled for a full suite of analytes in conjunction with CDPHE prior to initiating discharges. Discharge flow rates are monitored and recorded in real-time (5-minute intervals) by the Surface Water telemetry system. Discharges from Pond C-2 occur in a similar manner, except that inflow from the SID cannot be batched or discontinued.

3.2.3.2 Decision-Making and Operational Protocols - Routine Operations

Routine operations are defined as transfers and discharges of typically expected flows and volumes in the absence of suspected water quality problems. The routing of water transfers and discharges from Site ponds under routine conditions are schematically illustrated in Figure 2-3. A complete schematic of all potential flow and transfer routes, including value arrangements and other details, is shown in Figure 3-1.

Decisions associated with routine discharge operations made by Surface Water personnel include the following: (1) when to begin and end transfers from Ponds A-3 and B-5 to Pond A-4; (2) when to conduct pre-discharge sampling at Pond A-4 or C-2; (3) interpretation of analytical results; (4) what the discharge flow rate should be; (5) when to discontinue A-4 or C-2 discharges; (6) whether discharges or transfers should be discontinued in response to storm, spill, or upset events; and (7) and whether concurrent transfer of Pond A-3 or B-5 during a Pond A-4 discharge should occur. Surface Water personnel also make recommendations to DOE on the acceptability of water for discharge, and request approvals from DOE to begin discharges. However, the decision to actually conduct discharge operations is made by DOE. DOE, in turn, requests and generally receives concurrence from CDPHE prior to granting approval to EG&G to begin discharges.

Pond B-3 receives continuous flows from the Site WWTP. Operational protocols require this water to be detained during nighttime hours and released during daylight hours to Pond B-4 at a rate sufficient to allow storage of the next evening's effluent. Since Pond B-3 inflows consist entirely of WWTP effluent, and WWTP effluent is regularly monitored for parameters required by the current permit, no additional sampling is conducted on B-3 discharges. Pond B-3 volume fluctuates daily between 45 percent and 100 percent full.

Ponds A-3, A-4, B-5, and C-2 are currently operated whenever possible in a "batch" mode, where a distinct volume of water is collected and isolated from other inflows prior to being transferred or discharged. Operational protocols call for transfer of water from Pond A-3 to

Pond A-4 and transfer of water from Pond B-5 to A-4 to be initiated when pond volumes at Pond A-3 or B-5 approach 50 percent; however, Pond A-3 is routinely allowed to approach 90 percent based on its greater structural stability and higher allowable drawdown rate. Prior to transfer, Ponds A-3 and B-5 are visually inspected for turbidity and algal blooms, analyzed for pH and nitrate, and held for additional time if off-normal conditions exist. Transfer rates are determined by Surface Water personnel based on ambient pond volumes but are administratively limited to pond level drawdowns of 1 foot per day (Pond B-5) or 3 feet per day (Pond A-3) in accordance with USACE recommendations. Flow rates equivalent to a 1-foot per day drawdown are determined from pond level versus volume curves developed for the ponds by the "Pond Capacity Study" (EG&G 1993f).

Prior to off-site discharges from Ponds A-4 and C-2, samples are taken and split for analysis by CDPHE and EG&G. Since the current NPDES discharge permit for the ponds does not require <u>any</u> pre-discharge sampling, EG&G does not currently have a regulatorily required pre-discharge sampling suite. Generally, EG&G splits whatever samples CDPHE takes. The sampling suite taken by CDPHE varies from time-to-time based on their current interests but always includes the radionuclides, metals, and organics of general concern. The general list of analytes is shown in Table 3-12. Normally, pre-discharge sampling at Pond C-2 or A-4 is initiated when volumes approach 50 percent. Maximum level in Pond A-4 is set at 65 percent and transfers from A-3 and B-5 are generally stopped when levels at A-4 reach 60 percent. Current protocols require discharges from Ponds A-4 and C-2 to be discontinued when the ponds are at or below 10 percent of capacity, however, a decision to discontinue discharge at higher levels is made routinely in order to relieve high volumes in Pond B-5.

After approval from DOE is received, discharges from Ponds A-4 or C-2 are conducted 24 hours a day at a flow rate determined by Surface Water personnel based on 1 foot per day drawdown limitations. This drawdown limitation is the maximum drawdown rate recommended by the USACE dam stability analyses for these dams (USACE 1993).

Quite often, and particularly during the spring and summer, stormwater inflow conditions result in high pond levels in Ponds B-5 and A-3 that require transfers from Pond B-5 and/or A-3 to Pond A-4 to commence before a Pond A-4 batch discharge is complete. This decision, based on dam safety considerations, is made by EG&G Surface Water operations staff and is approved by DOE. DOE notifies CDPHE, and currently seeks formal concurrence from CDPHE for this operation. This situation occurred during 11 of 18 discharge cycles since September 1991.

As a final check on water quality, and for reporting purposes, samples of all discharges from Ponds A-4 and C-2 are collected daily and composited weekly for analyses of plutonium, uranium, and americium. Tritium, pH, nitrate, and non-volatile suspended solids are analyzed daily; chromium test samples are analyzed monthly while WET test samples are analyzed quarterly in accordance with the requirements of the NPDES-FFCA. Flows in Walnut Creek near its intersection with Indiana Street are also sampled quarterly for radionuclides. Current pond monitoring under the NPDES-FFCA and the AIP (DOE 1989) is summarized in Tables 3-5 and 3-12.

3.2.3.3 Decision-Making and Operational Protocols - Non-Routine and Emergency Conditions

Non-routine operations are defined as transfers or discharges from Ponds A-3, A-4, B-5, and/or C-2 in response to major storm events, routing or transfers of water to any of the identified spill control ponds (A-1, A-2, B-1, or B-2), and all operations conducted in response to potential or identified spills and upsets. All water treatment tasks, if needed, are considered non-routine operations, as are spray evaporation operations. Spray evaporation was routinely conducted at Pond A-2 and the Landfill Pond prior to July 1993. However, this practice was discontinued by DOE directive, has not been needed since that time, and is now considered a non-routine operation. References to protocols for spray evaporation within this section reflect protocols used prior to July 1993.

If Pond A-1 or B-1 is receiving water, and preliminary analytical results are available, operational protocols for Ponds A-1 and B-1 are to pump transfer Pond A-1 water to Pond A-2 when Pond A-1 volume exceeds 60 percent and to pump transfer Pond B-1 water to Pond B-2 when Pond B-1 volume exceeds 60 percent, unless a confirmed contamination is detected. In this case, Pond A-1 or B-1 is allowed to fill to capacity, if necessary, to avoid transfer of contaminants to Pond B-2 or A-2 for as long as possible. Absent reliable water quality analytical results, Pond A-1 or B-1 is allowed to fill until a defined emergency action level is reached, at which time water is pumped to Pond A-2 or B-2. Emergency action levels for these two ponds are defined as a water elevation within ½ foot of the spillway *and* further storms or inflow is predicted <u>*and*</u> other factors prohibit spray evaporation to reduce volumes below the action level. Action levels for these ponds are presented in Table 2-4.

For Ponds A-2 and B-2, current operational protocols call for pumped transfer of Pond B-2 to Pond A-2 when Pond B-2 volume exceeds 50 percent and spray evaporation of Pond A-2 water when its volume exceeds 50 percent. Alternatively, Pond A-2 can be transferred to Pond A-3 after demonstration of acceptable water quality; however, this has not happened to date. Generally, due to the small capacities of Ponds A-1, B-1, and B-2, and the desire to maintain the maximum amount of emergency spill collection capacity as possible, transfers to Pond A-2 are followed almost immediately by spray evaporation operations at Pond A-2. Prior to initiating a transfer of Pond B-2 or spray evaporation operation at Pond A-2, pond water is sampled and analyzed for Hazardous Substance List (HSL) metals, semi-volatile and volatile organics, gross alpha and gross beta, pH, and nitrates. Decision-making for transfers from Pond B-2 to Pond A-2 and for spray evaporation operations is as follows: operations commence only after demonstration to CDPHE's satisfaction that Segment 5 stream standards have been met for the parameters analyzed.

Spray evaporation operations are conducted during daylight hours only and are not conducted during unsuitable weather conditions (humidity greater than 80 percent for prolonged periods, sustained wind in excess of 30 mph, and/or air temperature less than 35°F) or after containment of suspect water in one of the ponds.

Independent treatment systems do not exist for Ponds A-1, A-2, B-1, or B-2, nor do pipelines exist that are capable of transporting contaminated water to existing treatment facilities. Surface Water personnel are currently investigating mobile water treatment capabilities which are expected to remedy this deficiency. It is important to note however that all water influents to these ponds since 1989 that occurred in response to "suspected" release, were subsequently confirmed to be not contaminated. Water volumes were successfully managed via natural and spray evaporation.

If pre-discharge sampling at Pond A-4 or C-2 indicates potential water contamination, additional samples are collected. Surface Water personnel then forward recommendations regarding treatment to DOE, who then consults with CDPHE. A final decision on whether treatment is warranted is made by DOE in conjunction with CDPHE based on the type of constituent(s) and concentration level(s) reported in the analytical results.

Formal decision criteria defining the water quality analytical results (i.e., constituents and concentration levels) at which treatment is required have not been established. Although by no means routine, exceedances of stream standards have occurred in pre-discharge samples. Typically, these exceedances are well below applicable Safe Drinking Water Act maximum contaminant levels (MCLs) and acute Aquatic Life water quality standards. Regulatory agencies and EG&G/DOE staff disagree on whether constituent concentrations nominally above stream standards warrant treatment prior to discharge. One of the goals of this document is to resolve this issue and avoid operational delays which may exacerbate dam safety considerations caused by high pond levels (see Chapter 7).

Emergency conditions are defined as uncontrolled spillway releases, any emergency downstream discharge, physical indications of actual or impending damage to dam structures, including actual dam failure, and major incidents potentially affecting water quality such as fires, explosions, or tank ruptures. The *Water Detention Pond Dam Failure* procedure contained in the EPIP (EG&G 1992) describes emergency response actions to be taken in the event of actual or potential unplanned releases of detention pond dam water, and defines seven action levels (0 through 6) for categorizing conditions at the dams up to and including dam failure. Action levels are specified for all stormwater control ponds except A-3, and represent the current definition of volume-related emergency conditions at these ponds. This procedure was recently revised to reflect the findings and recommendations of the USACE Stability Analysis and to add sampling requirements, but does not change the specified action levels. The new plan, entitled *Emergency Response Plan for Failure of Dams A-4, B-5, or C-2* (EG&G 1994c), is in final revision and is expected to be issued in late 1994.

For safety-related emergency conditions affecting Ponds A-3, A-4, B-5, and C-2, response actions include transfers to any other available pond, emergency water diversions, and emergency discharges. All emergency operations must be consistent with documented procedures, including activation of the EOC and specific requirements for notification and reporting to external agencies and local governments.

Emergency operations protocols in response to major incidents require immediate closure of the A-1 and B-1 bypass pipes, and discontinuation of all transfers and discharges until the situation can be properly assessed. Subsequent decisions to continue diversions, restart transfer or discharges, or take other actions to isolate or contain contaminants are made by EOC personnel in conjunction with state and local emergency response officials. Since the intent is to contain contaminants on Site property to the maximum extent possible, emergency, unmonitored release of presumably clean water from one or more ponds is a defined contingency action in order to maximize storage of known contaminants.

Treatment systems were established at terminal Ponds A-4, B-5, and C-2 beginning in February 1990. The consolidation of the B-5 and A-4 systems at Pond A-4 was completed in 1991. The consolidated treatment system at Pond A-4 consists of two parallel banks of particulate filter stations followed by two activated carbon adsorption vessels. A total of eight filter tanks holding six filters each and four 20,000-pound granular activated carbon (GAC) vessels are located at Pond A-4. The treatment system at Pond A-4 has a maximum treatment capacity of 1,200 gallons per minute, and is maintained and operated on a 24-hour basis when required. This system is located in a weatherproof enclosure and is dependable for reasonable operation during cold weather. The system at Pond C-2 consists of four filter tanks and two GAC vessels, is not protected from the weather, and is generally not usable from November through March. Although GAC is a Best Available Technology (BAT) for organic chemicals, and some metals and radionuclides are removed by particulate filtration, specific treatment capabilities for metals and radionuclides do not currently exist at either of these locations.

3.2.3.4 Implementation and Responsibilities

Physical activities associated with pond water management include sampling activities; operation, maintenance, and repair of pumps, piping, and valves for transfer, discharge, and diversion operations; operation, maintenance, and repair of spray evaporation and treatment facilities; maintenance, repair, and monitoring of dam structures; maintenance and monitoring of flow and water quality measurement devices, including the real-time telemetry system; and installation of identified improvements to pond water management facilities. Surface Water staff have overall responsibility for coordination of these activities, although physical completion of tasks involves a diverse combination of on-site and subcontracted labor. Each of these activities, and the responsible organizations, are briefly described below and are summarized in Table 3-13.

Sampling

Sampling activities are performed by subcontracted personnel under the direction of Surface Water staff. Approximately one-day notice is needed for scheduling sampling activities.

Water Transfers

Interior pond transfers (Pond A-1 to A-2, Pond B-1 to B-2, and Landfill Pond transfers) are conducted by on-site Liquid Waste Operations (LWO) personnel at the request of Surface Water staff. LWO staff also operate the outlet works of Pond A-3 for transfers to Pond A-4, and the A-1 and B-1 diversion gates in emergency conditions to divert stormwater flows to Pond A-1 or B-1. LWO staff are available 24 hours per day, 365 days per year. The valves on Pond B-3, which are opened each morning to release WWTP effluent to Pond B-5, and closed each evening, are operated by WWTP operators from the Regulated Waste Operations (RWO) organization. RWO also controls diversions of WWTP effluent to Pond B-1 or B-2, if needed, due to upset conditions. Daily operation of the B-3 valves is a routine practice not subject to Surface Water request. Surface Water staff can request B-3 valves to remain closed if warranted by operational conditions at Pond B-5. Pond B-5 transfers to Pond A-4 are pumped discharges rather than gravity releases, and are performed by subcontracted personnel under the direct control (administratively and contractually) of Surface Water staff. The subcontractor maintains operations personnel at the Site 24 hours per day, or as needed.

Spray Evaporation

Operation and maintenance of spray evaporation systems at the Landfill Pond and Pond A-2 are performed by LWO at the request of Surface Water staff. After spray operations are approved, LWO conducts daily operations until notified by Surface Water to discontinue.

Discharge

Discharge operations from Ponds A-4 and C-2 are pumped operations conducted by subcontracted personnel under the direct supervision of Surface Water staff. Discharge operations are staffed 24 hours per day as necessary.

Treatment Operations

Treatment operations at Ponds A-4 and C-2, if needed, are performed by subcontracted personnel under the direct supervision of Surface Water staff. All maintenance and repair activities associated with treatment operations are performed by subcontracted personnel rather than on-site maintenance crews.

Dam Monitoring

Responsibility for dam monitoring, including piezometer monitoring, arranging for annual dam inspections, and scheduling maintenance and repair efforts, was recently transferred from Surface Water to a new Watershed Management organization within the same directorate. Surface Water field personnel also take piezometer readings during routine field monitoring activities.

Volume Flow and Water Quality Monitoring

The real-time flow, pond level, and automated sampling equipment, including the associated telemetry system and computers, are installed, maintained, and calibrated by Surface Water engineers and technicians. Additional physical measurements of streamflows and pond levels are performed by Surface Water field technicians. Maintenance, repair, and installation of in-stream equipment (e.g., flumes and weirs) is specified by Surface Water field personnel, scheduled and performed by Plant Services labor crews, and inspected by Plant Construction Management personnel.

Maintenance and Repair Activities

Maintenance and repair of existing pumps, pipelines, valves, roads, berms, etc., are performed by Plant Services labor crews at the request of Surface Water staff, under the supervision of Plant Construction Management personnel. Equipment and material specifications, if needed, are determined by Plant Engineering personnel in conjunction with Surface Water operations staff.

Major Improvements

Major constructed improvements requested by Surface Water staff, such as new pipelines, treatment facilities, or other control structures, are designed by either Plant Engineering or outside architectural/engineering firms. Construction is generally performed by contractors under the supervision of on-site Construction Management personnel.

3.3 SUMMARY

This chapter has provided a broad overview of the current pond water management system at the Site. Numerous programs, plans, and procedures exist for water quality monitoring, spill prevention, and emergency response actions, as do defined operational protocols for management of pond water transfers and discharges. Although these procedures and operational protocols provide for effective pond water management, a number of constraints and potential areas of improvement are apparent.

From a structural standpoint, physical constraints such as transfer pipe diameters and dam safety requirements limit the range of available water management operations, especially during flow events on the order of the 100-year, 6-hour storm event. Operational decision-making is also constrained by existing monitoring and data analysis protocols which require lengthy time periods in order to adequately characterize water quality to very low concentrations.

Examination of Tables 3-4 through 3-10, which describe sampling requirements for stormwater, WWTP flows, ambient pond water, and OU discharges, indicates that the analyte lists and sampling frequencies are not the same for each source of water. Moreover, the analytical methods employed by contract and on-site laboratories, and field techniques employed in the various water quality monitoring programs may differ, and there are currently no protocols in place for the sharing and transfer of information between pond water managers and OU personnel. It is important to note, however, that the analytical methods used for pre-discharge and discharge samples have the lowest detection limits at the Site and provide reliable detection of low level contamination not achievable by other programs.

Table 3-13 highlights that current decision-making and implementation responsibilities for the various aspects of pond water management are divided among several different organizations. While Surface Water personnel have overall responsibility for much of the management of surface water, many important and integral operations and data management functions are associated with different internal organizations, and key steps in the decision-making process require input from external agencies. Because of this decentralization of authority, operational delays are uncontrollable, and as a result, unavoidable.

The above considerations affect the ability of operations and management personnel to conduct water management activities in the most effective and timely manner possible. While there is communication between internal organizations, and mechanisms are in place for coordination with external agencies, many opportunities exist for improved communication. In addition, streamlining the operational decision-making process, and centralizing decision-making authority in one organization would assist in more timely, comprehensive, and effective implementation of water management tasks.

Resolving these concerns is a key goal of this document and will have a positive impact on future implementation of pond water management strategies. Importantly, many of these concerns are organizational and systemic issues that can be resolved through increased coordination and sharing of information. Proposed improvements in pond water physical and administrative controls and implementation practices are discussed in Chapter 7.

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FIGURE 3-2
DAM SAFETY ACTION LEVELS FOR PONDS A-4, B-5, AND C-2

<u>A-4</u>

Action Level	Pond Level		Piezometer's Crest		Piezometer's Toe	USACE Action
Level-0	<5751	&	<5737[1]	&	<5718[2]	Stable
Level-1	≥5751	&	<5737[1]	&	<5718[2]	Stable
Level-2	≥5751	OR	≥5737[1]	OR	≥5718[2]	Increase Monitoring (3 days/week)
Level-3	≥5757	OR	≥5737[1]	&	≥5718[2]	Increase Monitoring (Once a day)
Level-4	5758	OR	≥5744	&	≥5718	Lower Immediately
Level-5	N/A		N/A		N/A	(Slough or over Spillway)
Level-6	N/A		N/A		N/A	(Failure)

[1]Value changed from previous value of 5735.
[2]Value changed from previous value of 5717.

<u>B-5</u>

Action Level	Pond Level		Piezometer's Crest		Piezometer's Toe	USACE Action
Level-0	<5797	&	<5785	&	<5757	Stable
Level-1	≥5797	&	<5785	&	<5757	Stable
Level-2	≥5797	OR	≥5785	OR	≥5757	Increase Monitoring (3 days/week)
Level-3	≥5803	OR	≥5785	&	≥5757	Increase Monitoring (Once a day)
Level-4	5804	OR	≥5785	&	≥5759	Lower Immediately
Level-5	N/A		N/A		N/A	(Slough or over Spillway)
Level-6	N/A		N/A		N/A	(Failure)

FIGURE 3-2
(Page 2 of 2)

C-2

Action Level	Pond Level		Piezometer's Crest		Piezometer's Toe	USACE Action
Level-0	<5760	&	<5755	&	<5737	Stable
Level-1	≥5760	&	<5755	&	<5737	Stable
Level-2	≥5760	OR	≥5755	OR	≥5737	Increase Monitoring (3 days/week)
Level-3	≥5764	OR	≥5755	&	≥5737	Increase Monitoring (Once a day)
Level-4	5765	OR	≥5755	&	≥5739	Lower Immediately
Level-5	N/A		N/A		N/A	(Slough or over Spillway)
Level-6	N/A		N/A		N/A	(Failure)

Note: Provisions should be placed in Action Level-2 for upgrading to a higher Action Level if deemed necessary by Plant Civil Engineering or SWD.

5.3 It is recommended in accordance with USACE recommendations: that additional piezometers be installed in the embankment to more accurately depict the phreatic conditions, that installation of crest movement markers and inclinometers be pursued, and that further geotechnical analyses be performed based on information from the additional piezometers. The amount and configuration of the additional instrumentation should be further evaluated by the geotechnical specialist. The geotechnical analyses should focus closely on, and correlate with, historical operation data. The additional geotechnical analyses should include operational and piezometer specific recommendations for inclusion in the EPIP.

TABLE 3-1
SUMMARY OF ADMINISTRATIVE PLANS AND PROGRAMS FOR THE MANAGEMENT OF WATER SOURCES INFLUENT TO THE PONDS

Plan or Program	Acronym	Description
Spill Prevention Control Counter-measures and Best Management Practices Plan	SPCC/BMP	References procedures and design criteria for containment, spill prevention, and response
Oil Pollution Prevention Plan	OPPP	Defines reporting requirements, storage facilities, and containment structures for management of petroleum products
Stormwater Pollution Prevention Plan	SPPP	Defines sitewide procedures and protocols for control of stormwater pollutants and flood events
Internal Spill Control Procedures	ISPP	Defines internal procedures and protocols for spills
Waste Minimization Program Plan	WMPP	Planning document for minimizing volume and toxicity of waste generated by site operations
Groundwater Protection and Monitoring Program Plan	GPMPP	Planning document for coordinating and evaluating groundwater research and monitoring activities
Integrated Watershed Management Plan	IWMP	Planning document for sitewide watershed management, restoration, and enhancement
Internal Building Containment		Required by order of decommission and decontamination activities
Work Plan for Control of Radio-nuclide Levels in Water Discharges from Rocky Flats Plant		Describes sampling and analytical methods used to characterize radio-nuclide concentrations in water discharges and discusses operational protocols and treatment approaches

TABLE 3-2
ACTIVITIES ASSOCIATED WITH SPILL CONTROL

Activity	Description
Reporting of Spill Events	Site personnel have been trained and instructed to report releases greater than or equal to one pound of solids or one pint of liquids.
Response to Spills	The HazMat Team was established to provide 24-hour response to hazardous materials occurrences at RFETS. This team provides emergency response to any significant environmental incident involving the release of a radioactive, toxic, or hazardous material, or a petroleum product. The team maintains a full-service response trailer on 24-hour standby to provide materials and equipment to contain and clean-up localized spills.
Incidental Water Management	Surface water, groundwater, utility water, fire water, or water originating from incidental sources such as construction activities or secondary containment structures is controlled, contained, sampled, analyzed, and treated or discharged according to procedures developed by Surface Water personnel and described in *Sampling of Incidental Waters* (5-21000-OPS-SW.16) and *Requirement for Control and Disposition of Incidental Waters* (1-C91-EPR-SW.01).
Cross-Connections to Footing Drains	Piped cross-connections and cracks or holes in the foundations or floors of buildings and structures that could allow spilled materials to be released to the environment are currently being corrected. These activities are undertaken to identify and correct building cross-connections which provide potential routes for contaminants within buildings to reach the outside.
Bulk Storage Tanks	Materials incompatible with the intended contents of the tank systems are controlled by labeling tanks and pipes for the proper material. New storage tanks containing regulated materials will be constructed with full secondary containment in accordance with *Engineering Plant Standard SM-136.*
Loading and Unloading Areas	Tank car or tank truck loading and unloading procedures are developed to comply with the provisions established by the Colorado Department of Public Health and Environment, the U.S. Environmental Protection Agency, the Occupational Safety and Health Administration, the Department of Transportation, and ASTM Method-136, *Standard for Tanks Containing Regulated Substances.*

TABLE 3-3
PHYSICAL CONTROLS FOR THE MANAGEMENT OF WATER AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Physical Control	Function
WWTP Equalization Basins	Isolate and detain potential spills to sanitary sewer and equalize flows to the
WWTP	Conventional activated sludge wastewater treatment facility
WWTP Effluent Storage Tanks[1]	Storage of WWTP effluent under upset conditions
WWTP Effluent Pipeline	Gravity pipeline paralleling the B-drainage ponds. Flow can be routed to any pond. Normal flow to Pond B-3.
Pond B-3	Receives daily WWTP effluent flows. Valved outlet controls flow to Pond B-4.
Process Wastewater System and Building 374 Evaporators	Closed loop collection and treatment of water used in plant production operations
Secondary Containment Structures	Berms around above-ground fuel storage tanks, process waste tanks, material storage areas, and miscellaneous equipment to contain leaks and spills
A-1 and B-1 Bypass Pipes	Diverts streamflows and stormwater around Ponds A-1, A-2, B-1, and B-2
Ponds A-1, A-2, B-1, and B-2	Collection and storage of spills and suspect water within A and B drainages
Landfill Pond to North Walnut Creek Transfer Pump and Pipeline	Transfer Landfill Pond water to North Walnut Creek above A-1 Bypass
Pond B-2 to Pond A-2 Pump and Transfer Pipeline	Transfer water from Pond B-2 to Pond A-2
South Inteceptor Ditch	Collect surface water runoff from south side of Site and route water to Pond C-2. Also receives OU 1 treatment system discharges.
Ponds A-3, A-4, B-5, and C-2	Primary stormwater collection and storage reservoirs for flood control and stormwater discharge operations
A-4 Treatment System	Treatment of stormwater for suspended solid contaminants and organic compounds tributary to the A- and B-series drainages
C-2 Treatment System	Treatment of stormwater for suspended solid contaminants and organic compounds tributary to Pond C-2
OU 1 Treatment System	Treatment of groundwater for organics, metals, and uranium
OU 2 Treatment System	Treatment of groundwater seeps for organics and radionuclides
OU 4 Interceptor Trench and Treatment System	Interception and treatment of groundwater for organics, nitrates, and radionuclides
OU 7 Leachate Collection and Treatmenet System[1]	Collection and treatment of multi-source/multi-contaminant leachate from the existing landfill
Pond C-2 to Pond B-5/A-4 Pumps and Transfer Pipelines	Transfer water from Pond C-2 to either Pond B-5 or Pond A-4. A spur section of this transfer line discharges to the Broomfield Diversion Ditch. The terminal section of this pipeline is used for routine Pond B-5 to Pond A-4 transfers.

[1]Proposed but not in place.

TABLE 3-4
SUMMARY OF STORMWATER MONITORING

Program	Location	Analytes	Frequency
Draft Revised NPDES Permit	Ponds A-4, B-5, C-2	Gross alpha/beta	Promptly after storm events of .5 inches or greater at least once per month during the second, third, and fourth quarters
		Dissolved copper, lead, zinc	
		Total recoverable iron	
		Atrazine, simazine	
		Plutonium, americium	
Event-Related Monitoring Program	Gaging Stations (Figure 3-2)	Gross alpha/beta	Approximately quarterly
		Plutonium, uranium, americium	Approximately quarterly
		Tritium (GS11, GS12, and GS13 only)	Approximately quarterly
		Nutrients, nitrate + nitrite (as N), phosphorus	Approximately quarterly
		Total dissolved target analyte list (TAL) metals	Approximately quarterly
		Total dissolved non-TAL metals	Approximately quarterly
		Water quality parameters	Approximately quarterly
		Pesticides/PCBs	By request from DOE
		Volatile organic analytes (CLP)	By request from DOE
		Flow	Continuously
Industrial Area IM/IRA	Six Drainage Outlets from Industrial Area	Flow	Continuously
		Others to be determined	At small increase in flow
	Sub-basin Outlet During D&D	Flow	Continuously
		Others to be determined based on COCs	At small increase in flow

TABLE 3-5
SUMMARY OF CURRENT POND MONITORING UNDER THE NPDES/FFCA

Location	Analytes	Frequency
Pond A-3 Discharge	Nitrate	Daily during discharge
	Flow	Daily during discharge
	pH	Daily during discharge
Pond B-3 Discharge	5-Day Biological Oxygen Demand (BOD5)	One time per week
	Total Suspended Solids (TSS)	One time per week
	Nitrate	One time per week
	Total Residual Chlorine (TRC)	Daily
	Flow	Daily
Pond A-4 Discharge	Whole Effluent Toxicity (WET)	Quarterly during discharge
	Non-Volatile Suspended Solids (NVSS)	Daily during discharge if outlet works are used
	Total Chromium	Monthly during discharge
	Flow	Daily during discharge
Pond C-2	Whole Effluent Toxicity (WET)	Quarterly during discharge
	Total Chromium	Monthly during discharge
	Flow	Daily during discharge
Pond B-5 Discharge	Whole Effluent Toxicity (WET)	Quarterly during discharge
	Flow	Daily during discharge
	Non-Volatile Suspended Solids (NVSS)	Daily during discharge if outlet works are used
	Total Chromium	Monthly during discharge

Adapted from: EG&G (1993 AA). RFP Surface Water and Sediment Monitoring Program Summary. January 1993.

TABLE 3-6
SUMMARY OF EXISITNG AND PROPOSED WWTP EFFLUENT MONITORING

Program	Analytes	Frequency
Existing NPDES-FFCA Permit	pH	Daily discharge
	Total Residual Chlorine (TRC)	Daily discharge
	Total Suspended Solids (TSS)	Two times per week
	Fecal coliform	Two times per week
	Total phosphorous	Two times per week
	Carbonaceous 5-Day BOD	Two times per week
	Flow	Daily
	Visible oil and grease	Daily
	Selected Target Analyte List (TAL) Metals	Once per month
	Selected Volatile Organic Analytes (CLP)	Once per month
	Total chromium	Weekly
	Whole Effluent Toxicity (WET) (acute)	Quarterly
Proposed NPDES Permit	pH	Daily discharge
	Total Residual Chlorine (TRC)	Daily discharge
	Total Suspended Solids (TSS)	Two times per week
	Fecal coliform	Two times per week
	Total phosphorous	Two times per week
	Carbonaceous 5-Day BOD	Two times per week
	Flow	Continuously
	Visible oil and grease	Daily
	Selected Volatile Organic Analytes (CLP)	Two times per month
	Total recoverable chromium, potentially dissolved cadmium	Two times per month
	Whole Effluent Toxicity (WET) (chronic)	Quarterly
	Nitrate, as N	Weekly
	Nitrite, as N	Weekly
	Ammonia, as N	Two times per week
	Silver (potentially dissolved)	Weekly
	Gross alpha and gross beta	Two times per month
	Americium, plutonium, tritium, uranium	Monthly
	Chloroform	Weekly 3 years after effective date of permit

Adapted from: EG&G (1993 AA). RFP Surface Water and Sediment Monitoring Program Summary. January 1993 and U.S. DOE and EG&G Rocky Flats, Inc. Permit No. CO-0001333, Major Federal Facility, Permit Renewal. Draft, February 1994.
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TABLE 3-7
PROPOSED WWTP INFLUENT MONITORING AND INSPECTION

Parameter/Condition	Frequency	Sample Type
Conductivity, μmhos/cm^2 at 25 C	Continuously	N/A
pH	Continuously	N/A
Lower explosive level of the atmosphere above the flow equalization basin	Continuously	N/A
Visual observation of the on-line flow of WWTP equalization basins for unusual conditions such as color, excessive foam, odors, oil sheen, etc.	Once per operating shift	N/A
Oxygen uptake rate of a grab sample taken from the on-line flow equalization basin in Building 990.	Once per operating shift	Grab

Source: U.S. DOE and EG&G Rocky Flats, Inc. Rocky Flats Plant Permit Number CO-0001333, Major Federal Facility Permit Renewal. Draft, February 21, 1994.

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TABLE 3-8
PROPOSED LIMITATIONS FOR NON-STORMWATER DISCHARGES TO THE WWTP

Parameter	Limitation
Total Toxic Organics (TTO)	2.1 mg/L
Flow	10,000 gallons/day
Volatile Organics of Concern	**Permissible mass, grams/day**
Benzene	7.1
Carbon tetrachloride	1.7
Chloroform	17
1,2-Dichloroethane	0.58
1,1-Dichloroethylene	79
Hexachloroethane	36
Methylene chloride	6.7
Tetrachloroethylene	3.0
Trichloroethylene	41

Source: U.S. DOE and EG&G Rocky Flats, Inc. Rocky Flats Plant Permit Number CO-0001333, Major Federal Facility Permit Renewal. Draft, February 21, 1994.

TABLE 3-9
OU 1 TREATMENT SYSTEM EFFLUENT MONITORING REQUIREMENTS

Constituent	Treatment Requirements	Constituent	Treatment Requirements
ORGANICS	**(ug/L)**	Mercury	0.002
Methylene Chloride	5	Molybdenum	0.1
Acetone	50	Nickel	0.2
Carbon Disulfide	5	Selenium	0.01
1,1 Dichloroethene	7	Silver	0.05
1,1 Dichlororethane	5	Strontium	NS
1,2 Dichloroethane	5	Thallium	0.01
1,1,1 Trichloroethane	200	Vanadium	0.1
Carbon Tetrachloride	5	Zinc	2.0
Trichloroethene	5	**INORGANICS**	**(mg/L)**
1,1,2 Trichloroethene	5	Calcium	NS
Tetrachloroethene	5	Magnesium	NS
Toluene	2000	Potassium	NS
METALS	**(mg/L)**	Sodium	NS
Aluminum	5	Total Dissolved Solids	400
Antimony	0.06	Chloride	250
Arsenic	0.05	Nitriteand Nitrate	10
Barium	1.0	Sulfate	250
Beryllium	0.1	Bicarbonate as (CaCO3)	NS
Cadmium	0.01	**RADIONUCLIDES**	**(pCi/L)**
Cesium	NS	Gross Alpha	15
Chromium	0.05	Gross Beta	50
Copper	0.2	Uranium (Total)	40
Iron	0.3	Strontium (89, 90)	8
Lead	0.05	Plutonium (239, 240)	15
Lithium	2.5	Americium (241)	4
Manganese	0.05	Tritium	20,000

TABLE 3-10
OU 2 TREATMENT SYSTEM EFFLUENT MONITORING REQUIREMENTS

Constituent	Treatment Requirements	Constituent	Treatment Requirements
ORGANICS	(ug/L)	Iron	1000
1,1-Dichloroethene	7	Lead	5
Carbon Tetrachloride	5	Manganese	1000
Chloroform	1	Nickel	0.2
Tetrachloroethene	1	Selenium	0.3
Trichloroethene	5	Zinc	0.05
Vinyl Chloride	2	Mercury	0.20
METALS - (Dissolved)	(ug/L)	Nickel	40
Iron	300	Selenium	10
Manganese	50	Zinc	50
METALS - (Total)	(ug/L)	**RADIONUCLIDES**	(pCi/L)
Aluminum	200	Gross Alpha	11
Arsenic	50	Gross Beta	19
Barium	1000	Uranium (Total)	10
Beryllium	100	Plutonium (239, 240)	0.05
Cadmium	5	Americium (241)	0.05
Chromium	10		
Copper	25		

TABLE 3-11
FLOW AND POND LEVEL SURVEILLANCES AND FREQUENCIES

Area Surveyed	Feature Surveyed	Frequency	Notes
Pond A-1 Bypass	Flow	2-3 times per week	Also monitored by telemetry
Ponds A-1 and A-2	Level	Weekly	Frequency is increased during precipitation
Ponds A-3 and A-4	Inlet Flow Level	2-3 times per week	Also monitored by telemetry
Piezometer DH-A3	Dam A-4 Toe	Weekly	Recently (9/94) connected to telemetry network
Piezometer DH-A1	Dam A-4 Crest	Weekly	Recently (9/94) connected to telemetry network
Piezometer WH-4	Dam B-5 Toe	Weekly	Recently (9/94) connected to telemetry network
Piezometer WH-1	Dam B-5 Crest	Weekly	Recently (9/94) connected to telemetry network
Piezometer WH-2	Dam B-5 Crest	Weekly	Recently (9/94) connected to telemetry network
Piezometer WH-3	Dam B-5 Crest	Weekly	Recently (9/94) connected to telemetry network
Piezometer DH-C2	Dam C-2 Toe	Weekly	Recently (9/94) connected to telemetry network
Piezometer DH-C1	Dam C-2 Crest	Weekly	Recently (9/94) connected to telemetry network
Ponds B-1 and B-2	Level	Weekly	Frequency is increased during precipitation
Pond B-5	Level Transfer flow rate Inlet flow from WWTP	2-3 times per week Continuous 2-3 times per week	Frequency is increased during precipitation
Pond C-1	Outlet flow	Weekly	Also monitored by telemetry
Pond C-2	Level	2-3 times per week	Frequency is increased during precipitation
Landfill Pond	Level	Weekly	
South Interceptor Ditch	Flow (at C-2 inlet)	2-3 times per week	

NOTE: Monitoring of piezometers installed in 7/94 begun in 8/94.

TABLE 3-12
SUMMARY OF CURRENT POND MONITORING UNDER THE AGREEMENT IN PRINCIPLE[1]

Location	Analytes[1]	Frequency
Pond A-3	Tritium	Daily during discharge
	Gross alpha/beta	Daily during discharge
	Field parameters	Daily during discharge
Pond A-4	Tritium	Daily during discharge
	Gross alpha/beta	Daily during discharge
	Nitrate	Daily during discharge
	Total Suspended Solids/Total Dissolved Solids	Daily during discharge
	Field parameters	Daily during discharge
Pond B-5	Field parameters	Daily during discharge
Pond C-2	Total Suspended Solids/Total Dissolved Solids	Daily during discharge
	Field parameters	Daily during discharge
Ponds A-4, B-5, and C-2[1]	TSS, TDS, anions, nitrate, alkalinity	Pre-discharge splits with Colorado Department of Public Health and Environment (CDPHE), and weekly splits with CDPHE during discharge. *pre-discharge only Note: This list is also performed quarterly at Pond C-2 during non-discharge periods.
	Gross alpha/beta	
	*Total radionuclides (Pu, U, Am, H3)	
	Semi-Volatile Organic Analytes (CLP)	
	Volatile Organic Analytes (Method 502.2)	
	*Pesticides (Method 608)	
	*Herbicides (Method 615)	
	*Triazine herbicides	
	Total and dissolved metals (TAL-CLP)	

[1]Specific analytes are not specified by the AIP. Current analyte list done by verbal agreement with CDPHE.

Adapted from: EG&G (1993 AA). RFP Surface Water and Sediment Monitoring Program Summary. January 1993.

TABLE 3-13
CURRENT RESPONSIBILITIES FOR POND WATER MANAGEMENT ACTIVITIES

Activity	Implementing Organization	Performing Organization(s)	Comment
Sampling	Surface Water Group	Subcontracted Personnel	Coordinate by Sample Management office
Analytical testing	Surface Water Group	Analytical Services Division Off-Site Laboratories	Coordinated by Sample Management office
Data analysis	Surface Water Group	Surface Water Group Statistical Applications Group	
Real-Time monitoring equipment installation, maintenance, repair, and operation	Surface Water Group	Surface Water Group	
Dam monitoring	Watershed Management Group	Watershed Management Group Surface Water Group	
Dam inspections, repairs, and maintenance	Watershed Management Group	Inspections-FERC, SEO, USACE Repairs/Maintenance-Plant Services	Supervision by Plant Construction Management Group
Flow and pond level monitoring	Surface Water Group	Surface Water Group	
Inspection, repair, and maintenance of water control facilities (pumps, pipelines, valves, flumes, etc.)	Surface Water Group	Inspection-Surface Water Group Repairs/Maintenance-Plant Services	Supervision by Plant Construction Management Group
Constructed improvements	Surface Water Group Watershed Management Group	Engineering-Plant Engineering, External A/E Firms Construction-On-Site CPFF Contractors, Off-Site Fixed Price Contractors	Construction supervision by Plant Construction Management Group

TABLE 3-13
(Page 2 of 2)

Activity	Implementing Organization	Performing Organization(s)	Comment
Pond B-3 discharge	Regulated Waste Operations	Regulated Waste Operations	Performed daily
Operation of A-1 Bypass and B-1 Bypass Diversion Gates	Surface Water Group	Liquid Waste Operations	
Spray evaporation	Surface Water Group	Liquid Waste Operations	
Landfill Pond transfers	Operable Unit 7 Program	Liquid Waste Operations	Coordinated with Surface Water Group
Ponds B-1, B-2, A-1, and A-2 transfers	Surface Water Group	Liquid Waste Operations	
Pond A-3 transfers to Pond A-4	Surface Water Group	Liquid Waste Operations	
Pond B-5 transfers to Pond A-4	Surface Water Group	Subcontracted Services	
Discharges from Pond A-4 and/or C-2	Surface Water Group	Subcontracted Services	
Treatment Operations at Pond A-4 and/or C-2	Surface Water Group	Subcontracted Services	
Installation, maintenance, and repair of treatment equipment	Surface Water Group	Subcontracted Services	

CHAPTER 4

WATER QUALITY

Existing water quality data are evaluated in this chapter for the purposes of: (1) assessing the historic water quality entering, residing in, and leaving the ponds; (2) identifying surface water quality concerns and their potential causes; and (3) establishing a list of drainage specific contaminants of concern (COCs) for the purposes of future operational monitoring.

Water quality data pertinent to pond management include: (1) background surface water quality and sediment geochemistry; (2) influent waters to the ponds; (3) water contained in the ponds; and (4) discharges from the ponds. Background surface water and sediment data establish the framework for comparing the quality of pond, sediment, and stream data to background upper tolerance limits (BUTLs). Influent water data are important to identify sources of potential contaminants flowing into the ponds, while the pond water data establish the ambient pond water quality. Water quality data for pond discharges are necessary to identify potential contaminants leaving the Rocky Flats Environmental Technology Site (the Site) terminal ponds. This chapter contains a comprehensive description and review of the major surface water programs at the Site as well as the data collected in these programs. Available data for background, ambient, and discharge water quality pertinent to pond management are discussed below in detail and are used to identify a list of COCs for monitoring purposes at the ponds.

4.1 BACKGROUND WATER QUALITY INVESTIGATIONS

Characterization of background quality and chemistry of Front Range water and sediment resources is essential to the development of chemical guidelines for the management of water quality at the Site. For example, background elements, such as radionuclides, are present in the Front Range environment in concentrations higher than the national average (National Council on Radiation Protection [NCRP] 1987). Background activities and concentrations are central to identifying anthropogenic contributions of contaminants to the environment.

4.1.1 Background Geochemical Characterization Program

From 1989 to 1993, the Site conducted the Background Geochemical Characterization Program for the purpose of obtaining data on the geochemistry of stream water, seep/spring water, stream and seep/spring sediments, groundwater, and geologic materials. Samples of these media were collected at stations located in Buffer Zone areas west, north, and south of the Industrial Area (IA), and were analyzed for radioactive isotopes, the U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) Target Analyte List (TAL) metals, EPA CLP Target Compound List (TCL) organics, major anions, and indicator parameters such as ph, specific conductance, and total dissolved solids (TDS). Surface water stations were sampled on a monthly basis during 1989, 1990, and 1991, then quarterly in 1992. Seep/spring water stations were sampled as part of the surface water sampling program on a monthly basis from 1989 through 1991 and quarterly in 1992. Stream sediments were sampled twice in 1989 and quarterly during 1990, 1991, and 1992 (EG&G 1993a).

Based on these data, tolerance intervals were calculated as one of the principal statistics used to characterize the chemistry of background stations at the Site. The upper and lower limits of the tolerance interval are estimated to contain 99 percent of the background sample values 99 percent of the time. The BUTLs may be used for "hot-spot" comparisons to samples collected on-site to help identify potential areas of chemical contamination. In addition to BUTLs, the mean, standard deviation, maximum concentration, sample size, the 85th percentile, and percentage of detectable concentrations were also provided in the *1993 Background Geochemical Characterization Report* (EG&G 1993a).

Surface water was also geochemically characterized and evaluated for seasonal trends. Stiff plots and Piper diagrams indicate that surface water is a calcium-bicarbonate type with low TDS. Seep/spring water contained a relatively greater portion of calcium than most of the stream water sampled in the study and probably reflects groundwater inflow. Chemical data for samples of surface water were tested for significant differences in geochemistry between seasons. No systematic seasonal variations in analyte concentrations were apparent in background surface water based on non-parametric analyses of variance (ANOVA) (EG&G 1993a).

Beginning in May 1990, sediments and surface water were sampled and analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Of these compounds, acetone and methylene chloride were detected most frequently in the samples; however, the presence of these compounds was believed to be a result of laboratory contamination. Trichloroethene, toluene, and tetrachloroethene were present at low concentrations in a few of the groundwater samples, mostly at estimated concentrations below the detection limit. Bis(2-ethylhexyl)phthalate and polynuclear aromatic hydrocarbons were present in a few of the stream sediment samples. The source of the bis(2-ethylhexyl)-phthalate was suggested to be due to the ubiquitous nature of phthalates in plastics, tires, etc., or as a lab contaminant,, and the polynuclear aromatic hydrocarbons were suggested to be from off-site burning of organic material (i.e., wood, trash) (EG&G 1993a).

4.1.2 Off-Site Reservoir Monitoring Program

Annual background samples were collected from Ralston, Dillon, and Boulder reservoirs, and from the South Boulder Diversion Canal at distances ranging from 1 to 60 miles from the Site. This monitoring program began in the early 1980s and was discontinued in October 1992. Samples were collected for background levels of plutonium, uranium, americium, and tritium. Concentrations of these constituents averaged 0.26 percent or less of the derived concentration guides (DCGs) established by the U.S. Department of Energy (DOE) for protection of human health. Reservoir water quality data were also compared with nine Denver area community drinking water supplies. There were no significant differences identified in radionuclide concentrations between these data sets.

The background concentrations of radionuclides in Front Range waters reflect natural radiation from radioactive minerals in rocks of the region, cosmogenic radiation, and atmospheric fallout from above-ground nuclear testing (NCRP 1987).

4.2 INFLUENT WATER QUALITY AND SUMMARY OF POTENTIAL CONTAMINANTS INFLUENT TO THE PONDS

Several sources of potential contamination affect pond water management at the Site and are pertinent to this document. Contaminants which have been detected in the environment on and around the Site include various radionuclides, nonradioactive metals, VOCs, SVOCs, and elevated inorganic ions. These contaminants may be found within groundwater, surface water, soils, and wastes at the Site, and may potentially leach into groundwater or surface water that eventually reaches the drainage ponds. These contaminants are present as a result of past residue and waste management practices that were acceptable at the time (e.g., waste incineration, discharges of contaminants to the drainages, or waste burial) and unplanned events such as leaks, spills, and fires. This section describes potential sources of contaminated influent to the ponds and summarizes available influent water quality data.

Potential sources of contaminated water entering the ponds which are discussed in detail in this section include:

1. Surface water baseflows influent to the ponds;

2. Sediment transport in drainages tributary to the ponds;

3. Stormwater flows influent to the ponds;

4. Wastewater treatment plant (WWTP) National Pollutant Discharge Elimination System-regulated (NPDES) discharges;

5. Footing drain discharges;

6. Discharges of treated water from interim or final actions at Operable Units (OUs);

7. Groundwater seeping directly into the ponds;

8. Landfill leachate seeping into the Landfill Pond; and

9. New uncontained on-site spills and releases from decontaminating and decommissioning (D&D) and/or discharge operations.

Other potential sources of contamination include atmospheric deposition (including precipitation) and flows from Coal Creek diversions which pass through the site. These two sources of potential contaminants were not evaluated in this document.

With the exception of new spills, the contaminants for the sources identified above are derived from the remobilization of existing on-site contamination. The locations at which these contaminants were released or currently reside are identified in the Interagency Agreement (IAG) as Individual Hazardous Substance Sites (IHSSs). The IAG identifies 178 separate IHSS locations at the Site. These IHSSs are grouped into 16 OUs for purposes of conducting field investigations and remediation activities (DOE et al. 1991). It should be noted that the landfill leachate seeping into the Landfill Pond is expected to be collected and treated by the summer of 1995 under OU 7 actions (Peterson-Wright 1994).

The following discussion identifies the influent contaminants of greatest significance to pond water management and does not emphasize specific IHSSs or OUs as sources of contaminants. Instead, it emphasizes the current effect of these sources on water quality influent to the ponds. The potential contaminant source list described above is considered adequate for the purposes of identifying likely COCs, as well as selecting and screening practical water management and treatment technologies that should be considered for pond water management. Each of these major potential sources of contaminants influent to the ponds is discussed below.

4.2.1 Surface Water (and Sediment) Baseflows Influent to the Ponds

Several drainages contribute influent water to the ponds. Ponds A-3 and A-4 receive a substantial portion of the North Walnut Creek and northern plant site runoff. Ponds B-4 and B-5 receive surface water influent from South Walnut Creek. Pond C-2 receives influent from the South Interceptor Ditch (SID). Surface water quality and sediment data available for these influent sources were generated during investigations and sampling activities associated with the *1989 and 1990 Surface-Water and Sediment Geochemical Characterization Reports* (EG&G 1992b; EG&G 1992c) and studies identifying contaminated sediment transport in drainages tributary to the ponds. The sediment data were reviewed to determine whether the drainages had the potential for contributing contaminated sediments to the ponds. The drainages may act as migration pathways for contaminated sediments to the ponds, especially during major storm events when the bottom sediments of the drainages are scoured, resuspended, and transported downstream. Both surface water and sediment data are discussed in more detail below.

4.2.1.1 *1989 and 1990 Surface-Water and Sediment Geochemical Characterization Reports*

The *1989 and 1990 Surface-Water and Sediment Geochemical Characterization Reports* (EG&G 1992b; EG&G 1992c) analyzed and interpreted surface water quality and sediment geochemical data at the Site to provide a plant-wide overview of contaminants in these media. In addition, the significance and impacts of past and potential future contaminant releases to, and transport via, the surface water pathway were assessed. Specific monitoring objectives were to: provide support for the characterization of background surface water and sediment quality; determine average conditions and summary statistics; determine exceedances or excursions beyond a defined limit; assess time trends and seasonality; evaluate spatial patterns; assess relationships between surface water quality and flow; assess relationships between surface water quality and sediment quality; delineate potential contaminant source areas; and assess contaminant fate and transport (EG&G 1992b; EG&G 1992c). The primary goal of each sample collected was to locate and assess areas with potential surface water contamination. For that reason, data on flow conditions were only collected where manual measurements could effectively be taken. Therefore, the resulting flow data primarily reflect baseflows or stagnant conditions in the creek channels and seeps.

Variables monitored during this program included VOCs and SVOCs on the EPA CLP TCL and pesticides/polychlorinated biphenyls (PCBs); metals on the EPA CLP inorganic TAL plus lithium, strontium, and tin; radionuclides; water quality indicator variables (i.e., nitrate, ammonia); and field variables prescribed by DOE, EPA, and the Colorado Department of Public Health and Environment (CDPHE). Sediment samples were collected from stream channels at numerous locations and were also analyzed for these parameters with the exception of some field variables, indicator variables, and the dissolved components of all variables. In addition, surface water stage and flow data were recorded during collection of selected water or sediment samples (EG&G 1992b; EG&G 1992c).

During the 1989 study, 73 surface water stations and 25 sediment stations were sampled as identified in Table 4-1 and on Figure 4-1. Surface water stations were sampled on a monthly basis and sediment stations were monitored on a semi-annual basis with a few exceptions.

Semi-volatile and pesticide/PCB analyses were conducted only on a semi-annual basis at all non-background surface water stations. Selected areas of interest discussed in the 1989 report included sampling locations grouped along Upper South Walnut Creek, the Lower SID, and the Landfill Area. This subset of the sample data was selected for discussion because of its direct upstream relationship to the ponds of interest to this IM/IRA document. Statistical results for selected 1989 sampling activities are contained in Table 4-2. It should be noted that the radionuclide data for 1989 were rejected by data validators; therefore, these data are of limited use (EG&G 1992b).

For the purposes of this document, the mean and maximum concentrations of constituents detected in the study were compared to Colorado Water Quality Control Commission (WQCC) Big Dry Creek Segment 4 and 5 stream standards (see Chapter 5 for more detail on these standards), when available, and to BUTLs when no stream standards existed. Stream standards were chosen because they provide an indicator of whether the metal, organic, or inorganic constituent concentration poses a threat to human health and the environment (aquatic life). For radionuclides, they provide a conservative measure of ambient water quality. For constituents such as magnesium and potassium, which are not toxic metals, BUTLs were used to gage possible anthropogenic contributions of these constituents to the environment. The results of these comparisons are provided below:

1. For samples collected on Upper South Walnut Creek, the mean (average) sample concentration exceeded Segment 5 stream standards for nitrate, total copper, total gross alpha, total gross beta, total americium-241, total plutonium-239, carbon tetrachloride, chloroform, vinyl chloride, and TDS. In addition, the maximum value detected for dissolved beryllium, dissolved copper, dissolved manganese, dissolved zinc, total iron, total lead, total uranium, radium-226, methylene chloride, tetrachloroethene, and trichloroethene exceeded stream standards. Several major cations also showed concentrations above BUTLs. VOCs which were detected, but had no corresponding stream standard for comparison, included 1,1-dichloroethane and acetone.

2. For the Lower SID, mean concentrations of compounds elevated above Segment 5 stream standards for Woman Creek included total gross alpha, total gross beta, total plutonium-239, total uranium, bis(2-ethylhexyl)phthalate, and TDS. In addition, compounds whose maximum concentrations exceeded stream standards included pH, nitrate, dissolved copper, dissolved iron, dissolved manganese, dissolved lead, dissolved zinc, total iron, total lead, total zinc, total americium-241, radium-226, uranium-233/-234, uranium-238, methylene chloride, and chloroform. Several major cations also showed concentrations above BUTLs. VOCs which were detected, but were below the corresponding stream standards, included ethylbenzene and trichloroethene.

3. Data were collected at several surface water sampling locations in the vicinity of the Landfill Pond. With the exception of SW098 (located at the east end of the pond), none of the other sampling locations are of direct interest to this document because the remaining sample locations are addressed as part of the OU 7 Action Memorandum. Thus, a discussion of stream standard exceedances based on the average of these sample locations is inappropriate. In addition, based on the discussion in the 1989 report, the majority of constituents elevated above background concentrations were at locations other than SW098. Constituents noted in the text as being elevated above background at SW098 include: specific conductivity, dissolved oxygen, chloride, carbonate, gross beta, and dissolved metals including magnesium, manganese, nickel, sodium, copper, and strontium (EG&G 1992a).

During the 1990 study, 98 locations were sampled. The major emphasis of the 1990 study was the identification of trends and processes affecting the nature and extent of contaminants in surface water and sediment. After verification of data by EG&G personnel, statistical and qualitative analyses were conducted to characterize major ion chemistry, identify areal trends for collected constituents, determine differences in constituent concentrations between background stations and downstream stations, and investigate geochemical trends and relationships. For statistical comparisons to background, a 95 percent confidence interval was used (EG&G 1992c).

The only organic constituents examined in the 1990 study were trichloroethylene (TCE), carbon tetrachloride, and toluene. These constituents were selected because they were believed to have been widely used in past Site operations and are also believed to be indicative of VOCs contamination at the Site. Surface water and sediment monitoring locations were grouped into several geographic areas for purposes of discussion. Selected areas pertinent to the ponds include sampling locations grouped along North Walnut Creek, South Walnut Creek, the SID, and the Landfill Area. Sample locations for each area are identified in Table 4-3. Results obtained for each of these areas are summarized below (EG&G 1992c). Statistical results for the 1990 monitoring program are contained in Table 4-4.

1. North Walnut Creek surface water did not appear to have metals concentrations above background concentrations. However, concentrations and activities for gross alpha, gross beta, plutonium-239/-240, tritium, uranium, and nitrite plus nitrate were found to be significantly different from background concentrations (EG&G 1992c). Based on comparison of mean values of these constituents to Segment 5 stream standards, only the mean activity for americium-241 exceeded standards. North Walnut Creek may act as a potential pathway for contaminant transport from the northern portion of the Protected Area and the Solar Ponds to the A-series ponds (EG&G 1992c).

2. South Walnut Creek surface water samples showed zinc, americium-241, gross alpha, gross beta, uranium, and nitrate plus nitrite concentrations/activities in concentrations significantly different from background concentrations (EG&G 1992c). Based on comparison of mean values of these constituents to Segment 5 stream standards, only the mean concentrations of americium-241 exceeded standards. These elevated concentrations could possibly be from groundwater seeps, leaks from broken steam and water lines, and runoff from building roofs, waste storage areas, and the ground surface which supplements natural baseflows in the creek; however, these sources were not thoroughly investigated (EG&G 1992c).

3. The SID showed gross alpha, gross beta, plutonium-239/-240, uranium, nitrate plus nitrite, and total suspended solids significantly different from background concentrations (EG&G 1992c). However, only the mean gross beta concentration exceeded Segment 5 stream standards. Possible sources of contaminants flowing into the SID include the old landfill, the 903 Pad, and the 903 Pad Lip Area (EG&G 1992c).

4. In the Landfill Area, statistical comparisons showed zinc, tritium, and total suspended solids significantly different from background concentrations but no mean for measured constituents exceeded standards (EG&G 1992b). As mentioned previously, the most likely source of contaminants into the Landfill Pond is leachate which will be collected as part of OU 7. The 1990 data do not indicate a contamination problem.

These two major reports provide essential supporting information on the quality of surface water and sediments influent to the ponds, and provide a preliminary identification of the sources and pathways for the transport of chemical constituents. Distinct differences in the chemical concentrations of certain elements, including metals, radionuclides, and VOCs are evident between and within basins. The differences in chemical concentrations may be reflective of source area contribution, particularly after storm events, or may be a result of geochemical processes which modify stream water quality, particularly in the case of metals. In addition, radionuclide concentrations in 1990 appear to be lower than in 1989. This difference is expected to be due to improved data quality in 1990.

4.2.1.2 Sediment Transport in Drainages Tributary to the Ponds

Transport of stream sediments may be a potential source of contaminants entering the ponds. The following discussion provides some basic background on the partitioning of plutonium between solution and solid phases and its tendency to sorb onto sediments. This background discussion is followed by several sediment transport studies which identify potential COCs for sediments as well as estimates of sediment transport to the ponds.

4.2.1.2.1 Background

In order to understand the impact of plutonium-contaminated sediment transport on the ponds, it is important to understand the basics of the partitioning of the solid and solution phases of plutonium in surface water. Fate and transport of dissolved radionuclides significantly differs from the fate and transport of particulate or colloidal phase radionuclides (Harnish et al. 1994). Specifically, plutonium tends to sorb from natural waters onto sediments. The corresponding solid-solution distribution coefficient (K_d) of plutonium-239/-240 in laboratory experiments ranges from 10^4 to 10^6. This distribution coefficient indicates that nearly all plutonium in water will tend to sorb onto sediments. Many factors influence the chemical speciation of plutonium, including redox kinetics, hydrolysis, and complexation by inorganic and organic ligands (Hamilton-Taylor 1993)

In the late 1970s, the phase partitioning of plutonium as a function of pH and contact time was investigated at Pond B-1. The results of the study showed that plutonium is generally not released from sediments once sorbed onto sediments unless pH increases above 9. When released, the plutonium is expected to be dispersed as discrete colloids or hydrolyzed species adsorbed onto colloidal sediment particles whose average size decreases with increasing pH above 9. Only about 5 percent of the total plutonium is expected to be dispersed at pH 12, and the dispersed plutonium seems to readsorb onto the sediment with time. Consequently, migration (or transport) of plutonium from the ponds is expected to be slow (Rees et al. 1978).

From a somewhat different perspective, groundwater studies at Los Alamos National Laboratory (LANL) indicate that plutonium and americium associated with colloidal materials may be mobile for great distances in sub-surface systems (Penrose et al. 1990). Subsequent studies found that fulvic and humic acids act as chelating agents and are effective in mobilizing not only plutonium and americium, but also uranium (and other metals). These acids have low molecular weight and high carboxylic group content and are found in natural organic material (Marley et al. 1993). However, in surface water environments, only about 5 percent of plutonium is expected to be associated with the colloidal form once it has been sorbed onto sediments (Rees et al. 1978; Hamilton-Taylor 1993). In addition, the organic content of sediments in Pond C-2 is known to be approximately 5 to 8 percent. This measurement is expected to be reflective of the general magnitude of organic content of sediments in the other ponds. This small organic content does not provide a large source of naturally occurring chelating agents (EG&G 1994d).

4.2.1.2.2 Site Sediment Transport Studies

Several studies have been conducted which identify sediment transport as a potential source of contaminants to the ponds. These studies include a Wright Water Engineers, Inc. (WWE) 1994 study, OU 6-related studies, and an evaluation of actinide transport in the SID.

WWE compared cross-sections of 1972 as-built drawings for Pond A-3 to a 1992 hydrographic survey of Pond A-3. The comparison showed that sediment deposition in the pond over the 20 year time period was approximately 1.6 feet in depth at a corresponding rate of approximately 1.3 tons per acre/year for the tributary watershed (WWE 1994).

During recent work conducted in support of the Phase I Resource Conservation Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) for OU 6, *Draft Technical Memorandum No. 4* (DOE 1994a) was generated for the purposes of identifying COCs in OU 6. These COCs will be used in support of OU 6's Human Health Risk Assessment (HHRA). OU 6 addresses 19 IHSSs, including the A- and B-series ponds, located in the Walnut Creek Drainage. Sediments transported in these drainages may have been contaminated by previous spills or releases of contaminants during the Site's history (Rockwell 1986). Stream sediment COCs identified as part of OU 6 activities are relevant to pond management because remobilization and deposition of stream sediments into the ponds, combined with in-pond chemical and physical processes, may contribute to contamination of the pond water (DOE 1994a).

The COCs were identified for stream sediments based on samples collected in North and South Walnut Creeks upgradient of the ponds during May 1993. These data were collected to help characterize potential contaminant transport through sediment mobilization in surface water pathways. The samples were analyzed for metals, radionuclides, VOCs, SVOCs, and pesticides/PCBs. These data were then statistically compared to streambed data reported in the *Background Geochemical Characterization Report* (EG&G 1993a). Radionuclides, organic compounds, and inorganic analytes above background levels were included in concentration/ toxicity screens to select OU-wide chemicals of concern. Arsenic, manganese, and barium were excluded from these screens because they were considered to be naturally occurring. All analytes that contributed at least one percent of the total risk factor were retained as COCs for quantitative risk assessment to be completed at a later date as part of the HHRA for OU 6.

Tentative COCs identified for stream sediments in this draft report include benzo(a)pyrene, benzo(b)fluoranthene, benzo(a)anthracene, indeno(123-cd)pyrene, cobalt, strontium, vanadium, zinc, plutonium-239/-240, and americium-241. In addition to these chemicals, benzo(ghi) perylene, dibenzofuran, and phenanthrene were also detected; however, they were not retained for quantitative risk analysis because they do not have EPA-established toxicity factors and cannot be evaluated in a toxicity- or risk-based screen. However, they will be evaluated qualitatively as part of the HHRA (DOE 1994a).

Other historical sources of contaminated sediments in Pond B-1 include pond reconstruction activities between 1971 and 1973 (DOE 1980). These activities resulted in disturbance of the bottom sediments in the channel upstream of Pond B-1, causing much of the upstream sediment to be transferred to Pond B-1, increasing its total inventory of plutonium. In addition, pond reconstruction and consequent redistribution of sediments affected the concentrations of plutonium in pond water. The majority of plutonium found in the water was associated with filterable solids of greater than 0.45 micrometers, which will quickly redeposit into the bottom sediments. Studies also showed that sediments act as a sink for plutonium in aquatic environments (Rockwell 1986).

A 1992 study, *Estimated Soil Erosion and Associated Actinide Transport of the South Interceptor Ditch Drainage*, modeled the impacts of the 881 Hillside French Drain construction and the SID maintenance activities on soil erosion and subsequent radionuclide transport to Pond C-2 via the SID. The study estimated that approximately 70 tons of soil has been eroded into the SID prior to the 881 Hillside French Drain construction. Approximately 7.2 percent of this sediment was estimated to have been transported to Pond C-2 and 92.8 percent was estimated to have been deposited into the SID. This resulted in an annual estimated sediment deposition of 31 pCi of plutonium-239/-240, 5 pCi of americium-241, 23 pCi of uranium-238, and 1 pCi of uranium-235 to Pond C-2. Since 881 Hillside construction has been completed, annual soil erosion has been estimated to have increased to 83 tons, 7.2 percent of which is expected to be transported to Pond C-2 for an annual deposition to Pond C-2 of about 37 pCi of plutonium-239/-240, 6 pCi of americium-241, 27 pCi of uranium-238, and 1 pCi of uranium-235 (EG&G 1992a).

When proposed SID maintenance activities are completed, soil erosion modeling results estimate that approximately 88.6 percent of the soil eroded from the SID drainage basin will be deposited in the SID and 11.4 percent will be deposited in Pond C-2. Approximately 49 pCi of plutonium-239/-240, 8 pCi of americium-241, 36 pCi of uranium-238, and 1.8 pCi of uranium-235 will be deposited annually in Pond C-2. The overall effect of the proposed SID maintenance activities is expected to be reduced sedimentation in the SID but increased radionuclide transport to Pond C-2 (EG&G 1992a).

4.2.2 Stormwater Influent to the Ponds

As described in Chapters 2 and 3, stormwater is a significant contributor of influent water to the Site pond system. Therefore, the quality of stormwater runoff is an important consideration in pond water quality management.

Stormwater quality has been monitored at the Site since 1989 as a part of a number of programs. The most recent and complete data regarding stormwater quality are contained in two reports, the *Event-Related Surface-Water Monitoring Report, Rocky Flats Plant: Water Years 1991 and 1992* (EG&G 1993b) and the *Stormwater NPDES Permit Application Monitoring Program, Rocky Flats Plant Site* (Advanced Sciences, Inc. [ASI] 1993). Additional data are contained within the actual NPDES permit application submitted to EPA in October of 1992, as well as the *Draft Surface Water Management Plan*. The first two reports are based upon a comprehensive set of analytes and are discussed below.

4.2.2.1 Event-Related Surface Water Monitoring Program

The purpose of this ongoing program is to collect, interpret, and disseminate available data on storm-related surface water hydrology and quality at the Site with an emphasis on the fate and transport of metals and radionuclides. The program began in late 1990. By spring 1991, 13 gaging stations had been installed (EG&G 1993b). Of the current 21 stations, only GS01 to GS13 are intended to be long-term stations for the monitoring of water quality and flow (Figure 4-2). The remaining stations are associated with OUs or other short-term projects and will be eliminated as they are no longer needed. Six gaging stations are of particular interest to pond water management due to their locations in relation to the ponds. GS09 and GS10 reflect stormwater influent to the B-series ponds; GS12 and GS13 reflect stormwater influent to the A-series ponds; GS27 reflects stormwater influent to Pond C-2; and GS-11 reflects stormwater quality below Pond A-4. The stations include hardware to continuously monitor water levels and collect water quality samples when stream stage increases in an effort to capture each run-off event (Wetherbee 1993).

The results of water quality and flow monitoring for the first two years of the program were evaluated and summarized in the *Event-Related Surface-Water Monitoring Report, Rocky Flats Plant: Water Years 1991 and 1992* (EG&G 1993b). Sample collection was limited to investigation of total radionuclides and total metals. Because the automatic samplers installed at the gaging stations cannot currently collect a representative sample for VOCs, a limited number of samples were manually collected specifically for organic analysis (EG&G 1993b).

Data analysis performed by EG&G during these two years used major cations (calcium, magnesium, sodium, and potassium) and trace metals (aluminum, iron, and zinc) to investigate relationships between constituent transport and sediment transport in the absence of suspended sediment data. In addition, stream discharge data were multiplied by constituent concentrations to calculate constituent loads for the purpose of evaluating fate and transport of constituents of environmental concern. Because of the limited quantity of flow data collected, the fact that analyte concentrations were near the analytical detection limit in almost all instances, and the questionable accuracy of flow data, only general conclusions could be made. For example, constituent loading was calculated by assigning one-half the detection limit to non-detects, which may have overestimated actual loading, particularly for metals such as lead, chromium, cadmium, and arsenic (EG&G 1993b). The following general conclusions were made based on observation of trends in the 1991-1992 data rather than extensive statistical analysis:

1. Total metal and radionuclide loads in Walnut Creek appeared to be higher than overall constituent loads in other Site drainages due to the runoff from impervious areas within the IA of the plant (EG&G 1993b). (However, these loads are expected to be small (EG&G 1994f).)

2. Total metal and radionuclide daily loads measured at gaging stations upstream from the A- and B-series detention ponds appeared to be higher than overall constituent loads measured at gaging stations downstream from the detention ponds. This suggests that the ponds may be removing constituents from the water column (EG&G 1993b).

3. Plutonium-239/-240 activity increased with increasing aluminum and iron concentrations in the Walnut Creek drainage, indicating that the plutonium appears to be associated with iron-coated or iron-containing aluminosilicates in transported suspended sediment (EG&G 1993b).

4. Uranium-238 activity and major cation concentrations decreased with increasing stream discharge at station GS13 on North Walnut Creek, indicating dilution of these constituents which were likely transported from natural sources. Trace metal concentrations increased with increasing stream discharge at GS13, indicating flushing of metals from impervious portions of the IA or from upgradient wetland areas (1993b).

5. Americium-241 activity decreased with increasing stream discharge at station GS10 in South Walnut Creek, indicating dilution of an americium-241 source (EG&G 1993b).

6. Major cation and trace metal loads were within the same order of magnitude in each Site drainage, indicating no obvious anthropogenic source of trace metal constituent loading to Site streams (EG&G 1993b).

7. Pesticides and SVOCs were monitored during two storm events with no compounds detected at detections limits ranging from 10 to 50 $\mu g/L$ (EG&G 1993b).

Although no new report has been issued since the event-related report of 1993, data have continued to be collected at the gaging stations and an event-related report containing the results of water year 1993 is expected to be released in October 1994 (Wetherbee 1994). These data are expected to supplement and refine the general observations described above and are expected to contain more accurate discharge data than the 1991 to 1992 data (Wetherbee 1994). Water quality data collected during 1993 have been added to the 1991 and 1992 data set and are summarized for stations GS09 through GS13 and GS27 in Table 4-5. The test method used for metals analyses, inductively coupled plasma emissions spectrometry (ICPES), had relatively high detection limits. Additional data for selected metals were also collected at GS09 through GS11 and GS13 during this time period and analyzed using two test methods with significantly lower (approximately one magnitude lower) detection limits than ICPES. The two new methods included inductively coupled plasma mass spectrometry (ICPMS) and graphite furnace atomic adsorption (GFAA) (Wetherbee 1994). The results of the ICPMS and GFAA metals analyses are contained in Tables 4-6 and 4-7, respectively.

Although data are available for most of the gaging stations, stations GS09 through GS13 and GS27 are of direct interest to pond water management. Observations based on the available data for these gaging stations and selected conclusions obtained from the *Event-Related Report for 1993* (EG&G 1994b), which is to be released in October, are described below:

1. For the majority of the dissolved metals analyses (using any of the three test methods), greater than 75 percent of the sample values for each metal fell below the method detection limit (MDL). The exceptions were antimony and lead, which showed a greater number of values above the MDL for the ICPMS data. All of the GFFA data were below MDLs.

2. Although a greater percentage of total metals data were above the MDLs, only a few metals' mean concentrations exceeded stream standards. Stream standards were exceeded by the average concentrations of: lead at GS09, GS10, and GS13; copper at GS10; thallium at GS09, GS10, GS11, and GS13; and antimony at GS10. The majority of these exceedances were noted using the ICPMS test method.

3. For locations influent (GS12 or GS13) to the A-series ponds, mean concentrations or activities of constituents exceeding stream standards included plutonium-239, and total thallium and lead.

4. For locations influent to the B-series ponds (GS09 or GS10), mean concentrations or activities of constituents exceeding stream standards included americium-241; plutonium-239; dissolved and total antimony and lead; dissolved copper; and total thallium.

5. For locations influent to Pond C-2, the only constituent exceeding stream standards in the one sample taken at GS27 was gross alpha.

6. For GS11, which reflects stormwater downstream of Pond A-4, the ICPMS mean value for total thallium exceeded stream standards.

7. For purposes of general comparison of radionuclide concentrations against stream standards at individual gaging stations and between gaging stations, a histogram was created for radionuclides based on Table 4-5. This histogram compares the cumulative number of radionuclides analyzed against the cumulative number of stream standard exceedances at each station. This histogram, contained in Figure 4-3, graphically shows that GS10 and GS13 had greater numbers of samples taken than the other four stations; likewise, they also had more exceedances documented.

8. Plutonium-239/-240 and americium-241 are predominantly associated with transported particulates, and uranium isotopes are associated primarily with dissolved constituents. Therefore, pond management strategies which involve adequate holding time for settling and treatment technologies which involve ultrafiltration may be considered appropriate for plutonium-239/-240 removal from pond water (EG&G 1994f).

9. A majority of the stormwater samples collected at stations GS10 and GS09 indicate that particulate-bound plutonium and americium are removed from the water column in Pond A-4, but this removal is inconsistent. As would be expected, uranium isotopes are more mobile than plutonium-239/-240 and americium-241; thus, uranium is observed to pass through Pond B-4 to Pond B-5 (EG&G 1994f).

10. Transport of actinides at GS10 is variable, probably as a result of runoff from various sources in the GS10 drainage basin. Actinide transport at GS13 is more consistent between storms, most likely due to runoff generation from the same portion of the GS13 drainage area. Correlations between actinide activity and other environmental variables such as discharge and total suspended solids (TSS) can be used to predict actinide transport at GS13, but not at GS10 or many other gaging stations. More data will be needed throughout the gaging station network to construct predictive models for estimating actinide transport (EG&G 1994f).

11. Sediment-associated actinide transport to A- and B-series detention ponds is expected to be small. Based on calculations in the draft report for water year 1993, the estimated sediment-associated mass transport of plutonium-239/-240 to the A- and B-series ponds is less than 10 milligrams per year (0.7 mCi/yr) (EG&G 1994f).

12. Actinide activities are higher at GS10 and GS13 than at other Site gaging stations, resulting from a major source of actinides in the IA (EG&G 1994f).

Analysis and evaluation of these studies provides a preliminary identification of the potential impact of stormwater discharge on water quality in the ponds. Because stormwater runoff occurs as overland flow in disturbed and impermeable areas such as roads, any contaminants associated with these areas are accumulated from the ground surface and transported with overland flow towards the ponds. Therefore, stormwater quality will essentially reflect the constituents located in the contributing drainage areas.

Based upon the available data, several reasonable hypotheses with regard to chemical associations were identified in these studies. For example, the association between plutonium-239/-240 and iron-coated aluminosilicates provides both a potential indicator for use in monitoring (iron and alumina concentrations) and a mechanism for retention of plutonium on sediments and removal from the water column. In addition, there appears to be a dilution effect from increased storm runoff; however, the dilution does not appear to affect all parameters and does not necessarily reflect a predictable pattern. As the Event-Related Monitoring Program continues, more information on these patterns should become available and should be integrated into this IM/IRA document.

Finally, and perhaps most importantly, the differences in metal and radionuclide concentrations upstream and downstream of the ponds clearly indicate that the ponds function to remove contaminants from the water column. Rather than viewing the ponds as simply water detention devices, the ponds may in fact be treatment systems that have a critically important role in modifying water quality at the Site.

4.2.2.2 Findings of the Stormwater NPDES Permit Application Program

The Stormwater NPDES Permit Application Monitoring Program was conducted in response to the Clean Water Act (CWA) NPDES requirements. The goal of the program was to collect water quality samples during storm runoff or high flow events at selected sites to characterize runoff quantity and quality at the Site (ASI 1993). A total of 116 surface water samples and 19 bulk-precipitation samples were collected and analyzed during a 15-month period from October 1991 through December 1992 during 32 storm or high-flow events. Chemical analyses were performed for surface water samples for selected trace metals, anions, and nutrient species. Sampling activities included first-flush and hydrograph-integrated flows (ASI 1993).

The report summarizing the results of this program is entitled *Stormwater NPDES Permit Application Monitoring Program, Rocky Flats Plant Site*. It provides data on precipitation, hydrologic parameters, including mean daily discharge and event-specific discharge, and water quality for the six NPDES monitoring stations located in the main channels that drain the IA. Sample locations in the program included SW022, SW023, SW027, SW093, SW118, and SW998 (Figure 4-2). The resulting report describes the comprehensive results of the monitoring program, including water quality data and stream flow records of stormwater events (ASI 1993). Table 4-8 shows the total drainage area captured by each of the NPDES stations as well as the percentage of each drainage consisting of the IA.

SW023 and SW027 have been routinely monitored since October 1992. After data collection for the NPDES stormwater permit was completed, monitoring of the remainder of the stations ceased. However, SW093 was reintroduced into the stormwater program in March 1994, and SW988 was reintroduced into the program in June 1994. SW022 and SW118 will be brought back on-line in late 1994 as part of the event-related stormwater monitoring network (Wetherbee 1994). EPA has not yet finalized the monitoring requirements under the forthcoming stormwater permit, including sampling locations, parameters, and sampling frequency.

Table 4-9 summarizes the first flush sampling data. The first-flush sampling was accomplished by collecting samples from the beginning of the storm runoff at 1.5 minute intervals until the stream channel stage declined below a pre-set level, or alternatively, all 24 sample bottles were filled. These samples provided a characterization of the "first flush" from the drainage areas that occurs within the first 30 minutes of storm runoff or high flow.

Table 4-10 summarizes the hydrograph-integrated stormwater quality data for surface water stations. The integrated samples were taken from the beginning of the storm runoff at pre-set time intervals until the stream-channel stage declined to a pre-set level. Generally, these samples provided an integrated water quality characterization over the prolonged storm runoff/high flow hydrograph period (ASI 1993).

All the metals reported in the Tables 4-9 and 4-10 are total recoverable metal concentrations. Aluminum and iron consistently had the highest concentrations in the storm-runoff samples. Anion and nutrient species concentrations at all sites were judged to be at reasonable levels associated with storm runoff. Only one storm event was successfully sampled for organics due to the timing of the storm events coupled with the standard sampling methods which necessitate manual "grab" samples (ASI 1993).

For stormwater event samples, maximum and average concentrations for many of the trace metals and major ions analyzed were higher in first-flush samples than with hydrograph-integrated samples with the exception of SW023 and SW027. When comparing site-by-site average hydrograph integrated concentrations, each site exhibited a varying number of cases when relatively high concentrations were reported (ASI 1993). Comparison of the average values of the hydrograph-integrated and the first-flush data at the various gaging stations to WQCC stream standards showed high concentrations of antimony, copper, iron, lead, selenium, thallium, and ammonia. Zinc was above standards in the first-flush sample data but not in the hydrograph-integrated data.

Stream discharge and water quality relations were evaluated for selected storm runoff events. Variations of specific conductance as a function of discharge occasionally exhibited an erratic pattern; however, in several instances, a more normally expected dilution pattern of lower specific conductances with higher discharges, as well as hysteresis effects during given hydrographs, was noted. However, dilution and hysteresis effects are not consistent in pattern for any given storm event at all sites. Trends are not apparent on a sequential basis (ASI 1993).

A qualitative review of Tables 4-9 and 4-10 does not indicate any large differences between the quality of water from sampling areas where all or a majority of the drainage area is in the IA as compared to sampling areas where only a portion of the drainage area is the IA (Table 4-4).

4.2.3 WWTP Discharges

The WWTP discharge may contain contaminants based on the following scenarios:

1. The past release of contaminants or materials to the WWTP (these materials may have become resuspended from contaminated sludge or sediment);

2. The current release of contaminants or materials to the WWTP;

3. The infiltration or inflow of contaminants or materials entering sanitary sewer lines to the WWTP influent; and/or

4. Creation of compounds through chlorination of the WWTP effluent.

Historical Site operations introduced a number of compounds or materials to the WWTP in decontamination laundry wastewater and other wastewaters that are no longer considered suitable for discharge to the WWTP. Some of the compounds and materials that were discharged to the WWTP are known to have contributed to radionuclide contamination of sediments in the on-site drainage ponds and off-site Great Western Reservoir.

Contaminants may also still be present in sediments and sludge that have accumulated in the sanitary sewer lines and in the WWTP, although many of the sewer lines have been replaced, lined, and cleaned in recent years. The potential for resuspension of these contaminated sediments and sludge into the WWTP effluent is considered to be at least partly responsible for the current EPA designation of the WWTP sludge as a low-level radioactive contaminated waste. Although the presence of contaminants and materials in the WWTP effluent is expected to decrease with time, the possibility of the presence of such materials should be considered for WWTP effluent and pond water management.

A second potential source of contamination in the WWTP effluent is current releases. Although numerous preventive measures are available to protect the WWTP from unacceptable contamination, accidental spills and releases will always be a potential source of contaminants. Forty-two industrial waste streams totaling approximately 0.02 million gallons per day are routinely discharged to the WWTP. These streams are strictly screened for hazardous waste. In addition, discharges from small cooling towers may also be infrequently discharged to the WWTP. Based on routine flows, these industrial waste streams account for 10 percent of all flows to the WWTP (DOE 1992c).

A third potential source of contaminants in the WWTP effluent is from the infiltration or inflow of materials and compounds into the sanitary sewer lines that lead to the WWTP (ASI 1991). These materials and compounds may be present in groundwater, surface water, stormwater, or soils, as a result of past waste management practices and spills, and may find a route of entry into the sewer lines that lead to the WWTP (ASI 1991). To address this problem, many of the older sewer lines leading to the WWTP have been sleeved. As site groundwater and general environmental characterization becomes more detailed, any sources of contaminated infiltration and inflow will be identified and considered for remediation. However, until that time, it is necessary to address the possibility of contaminated infiltration and inflow occurring to the WWTP influent.

Finally, occasional upsets in the operation of the WWTP can cause unusually large amounts of residual chlorine to enter the waters of the holding ponds, or can increase the amounts of nutrients or organic matter that enter the ponds along with WWTP discharge. Excess amounts of residual chlorine potentially have negative effects on aquatic life in the ponds, although such effects are usually narrowly constrained to the immediate vicinity of discharge because of the rapid dissipation of chlorine in surface waters. More importantly, the entry of large amounts of nutrients, particularly phosphorus, as a result of an upset in WWTP operations can stimulate the growth of algae, which in turn may develop large populations (algal blooms) that could reach nuisance proportions associated with scum, odor, and possible oxygen depletion in deep water. In addition, an upset in WWTP operations could result in the discharge of abnormal amounts of organic matter, which could lead to the depletion of oxygen in the pond, particularly near the bottom, and could stimulate algal growth indirectly through nutrients that are produced by biodegradation of organic matter in the pond (Lewis 1994).

Discharges from the WWTP are regulated by a NPDES permit issued under the authority of the CWA and modified by the Federal Facilities Compliance Agreement (FFCA). With minor exceptions, the WWTP has consistently complied with all provisions of its NPDES-FFCA permit since 1991 (DOE 1992a). Table 4-11 summarizes WWTP effluent water quality for the period 1991 to 1993. Three exceedances noted for the NPDES permit and their probable causes as determined by EG&G staff during this time period include:

1. In May 1992, total residual chlorine (TRC) readings at the WWTP outfall were higher than normal, exceeding the capacity of the field measurement technique (2.0 mg/L). There is no daily maximum limit for TRC included as part of the permit terms for this outfall, although the results are reported. It was determined that the WWTP was backflushing one of the clarifiers at the time the readings were taken, resulting in a high TRC content due to low flow conditions. The dechlorination equipment was corrected to remedy the periodic surges of high TRC during backflushing operations (DOE 1992a).

2. In July of 1992, low flow conditions at the WWTP influent caused an imbalance in the dechlorination system (based on sulfur dioxide) and resulted in a low pH at the effluent. The condition was detected by samplers and corrected immediately by application of lime to the WWTP. The effluent pH was returned to above the minimum permit value of 6.0 within an hour after the condition had been detected (DOE 1992a).

3. On December 28, 1993, the pH of WWTP effluent was measured at 5.78, below the lower limit (6.0) of the allowable operational range. The cause was attributed to pump problems which resulted in temporary low flow conditions. Corrective actions were taken to prevent a recurrence of this problem (Burdelik 1994).

4.2.4 Footing Drain Discharges

Foundation drain systems for buildings and structures in the IA are potential sources of contaminants for surface waters at the Site. Water collected in the foundation drains is discharged to either storm sewers, sanitary sewers, building sumps, or surface outfalls. Foundation drain water may then reach the ponds through exfiltration of water from the sewers or through direct discharge to surface outfalls. Several specific examples of footing drain flows which may affect the ponds include Buildings 371/374, 707, and 774. Six outfalls for Building 371/374 and Substation 517/518 discharge into a north-flowing drainage ditch that contributes water to North Walnut Creek. Building 707 foundation drains tie into a storm sewer which outfalls east of the building and eventually enters the B-series ponds. Building 774 foundation drains drain to three outfalls, at least one of which drains to a storm drain, which in turn flows into a small pond north of the building and then into North Walnut Creek (EG&G 1994a).

The *Draft Technical Memorandum No. 1 for Operable Unit No. 8* (EG&G 1994a) compiled available historical data on footing drains for the purpose of evaluating the influence of these drain systems on groundwater and surface water flow and contaminant migration. Available data were also reviewed to assess the quality of foundation drain waters and the adequacy of the current footing drain monitoring program. Although footing drains have been sampled throughout the Site's history, sampling frequency and parameters have been irregular, enabling only limited evaluation of the data. Comparison of available footing drain data to BUTLs for surface water showed elevated concentrations of various metals, gross alpha, and gross beta. Specifically, aluminum, arsenic, chromium, copper, iron, lead, manganese, selenium, and zinc exceeded surface water BUTLs at various foundation drain locations. Concentrations of calcium, sodium, potassium, and magnesium also commonly exceeded BUTLs. As of November 1993, most foundation drains and building sumps had been analyzed for VOCs and SVOCs only once organics were detected in samples from 11 of 19 sampling stations. A wide variety of chlorinated organic compounds such as chloroform, carbon tetrachloride, tetrachloroethene, 1,1,1-trichloroethane, and dichloroethene compounds were detected in foundation drain samples. In addition, acetone and bis(2-ethylhexyl)phthalate were also detected in some samples. While the volume of water in the footing drains is not large in comparison to storm runoff, the concentration of chemical contaminants may be significant. Although contaminated flows from foundation drains will be addressed as part of OU 8, the current and historic outflows from these drains are relevant to pond water management and should be recognized as potential sources of contaminants (EG&G 1994a).

4.2.5 Discharges From OUs 1 and 2

The discharge of treated water to drainages on the plant site is currently taking place from OUs 1 and 2. OU 1 addresses the 881 Hillside and OU 2 addresses the 903 Pad, Mound, and East Trenches. At OU 1, groundwater and infiltrate are collected in a french drain and treated for radionuclides, metals, and volatile organics. Influent flows collected for treatment at OU 1 total approximately 30 gallons per minute; however, the treatment plant is operated on an intermittent basis (Burmeister 1994). Treated effluent is released to two 150,000-gallon effluent storage tanks for testing. The water is then released to the SID intermittently as the tanks fill. In the spring, water is released approximately every two weeks, and during other times of the year, once per month. Since the OU 1 treatment facility became operational in 1992, concentrations of contaminants in the treated effluent have consistently met applicable or relevant and appropriate requirements (ARARs) (DOE 1993a). However, in November 1993, an unanticipated release of treated effluent occurred from the system which contained dissolved iron slightly in excess of its ARAR (EG&G 1994b).

At OU 2, one groundwater seep is currently collected and piped to the OU 2 field treatment unit for removal of radionuclides, metals, and volatile organics. Influent flows collected for treatment range from approximately one-half gallon per minute to one gallon per minute. Treated effluent totalling approximately 9,000 gallons is discharged to South Walnut Creek upstream of the B-1 Bypass on a bimonthly basis over a three to four hour time period (Vess 1994). Mean concentrations of treated effluent released from the OU 2 treatment facility have consistently been below ARARs. However, on one or two individual sampling occasions, dissolved manganese, copper, lead, zinc, americium-241, and plutonium-239/-240 exceeded ARARs. Aluminum exceeded ARARs on four occasions (DOE 1993b).

As OU characterization and remediation proceeds, more discharges of treated water to the ponds could occur. OU 1 and 2 discharges, future discharges of a similar nature from other OUs, and the potential for upsets should be factored into any proposed modifications to pond water management.

4.2.6 Groundwater

Groundwater seepage into surface water and into the ponds may be a potential source of contaminants to the ponds. Recent reports which address the interaction of groundwater and surface water include *Groundwater/Surface Water Interaction Study* (CSU 1993) and the *Draft Final Technical Memorandum No. 15, Addendum to the Phase I RFI/RI Work Plan for OU 5* (EG&G 1994). In addition to these reports, data collected during 1991 and 1992 from an OU 2 monitoring well (No. 3687) compared with data collected in Pond B-2 indicate that volatile organic contamination to the pond may be occurring by groundwater migration through alluvial materials. The data suggest that contaminant concentrations may be greatest during winter months. This may be due to contaminant trapping under the winter ice pack and the subsequent slowdown of natural degradation processes. Compounds of interest include 1,2-dichloroethene isomers, trichloroethene, and carbon tetrachloride (Litus 1994).

Both of the published reports mentioned above focus on Woman Creek, which is influent to Pond C-1. Because historical observations of Woman Creek suggested that sections of the creek gained and lost water as the creek transversed the Site, delineation and quantification of surface-water/groundwater interactions in Woman Creek were completed as part of the OU 5 Phase I RFI/RI (EG&G 1994b). A series of shallow monitoring wells was installed along Woman Creek and its tributaries to monitor water levels. Based on data collected from these wells during the December 1991 through October 1992 period and during the March 1993 through February 1994 period, individual reaches of Woman Creek were characterized as generally gaining or losing water during certain periods of the year. Gaining reaches on nearly a year-round basis include the original Landfill Area and the old firing range area. These gaining reaches may be significant receptors of contaminants from known sources within the original landfill and OU 2, respectively. Contaminants picked up in these reaches have the potential to impact water quality in downgradient ponds (EG&G 1994d). Because gaining and losing reaches of the creeks at the Site are expected to vary from year to year, depending upon streamflows and the position of the water table, contaminant transport to the ponds through groundwater inflow is expected to vary.

As discussed in Chapter 2, the exact quantification of groundwater inflows to the ponds and to streamflow is a difficult process because of the complexity of the groundwater and surface water system at the Site. It may be possible, however, to use selected organic and inorganic chemical indicators to assess the relative contribution of groundwater to the ponds, and then to estimate contaminant loading to the ponds from the groundwater system.

4.2.7 Landfill Leachate

The landfill was designed for the disposal of the Site's non-radioactive solid waste. Use of the landfill began in August, 1968, and the landfill is still in use at this time. The non-hazardous waste disposed of at the landfill includes office trash, paper, rags, demolition materials, empty cans and containers, used filters from the filtration of machining oils and coolants, and various electrical components. Additionally, dried sanitary sewage sludge, solid sump sludge, and other miscellaneous sludges were disposed of in the landfill during the 1960s and 1970s. In 1986, it was determined that some of the wastes being placed in the landfill were hazardous wastes (DOE 1992).

The four general categories of hazardous waste streams disposed of in the landfill included: (1) partially filled containers of paint, solvents, degreasing agents, and foam polymers; (2) wipes and rags contaminated with these materials; (3) used filters that may have contained hazardous constituents; and (4) metal cuttings and shavings coated with hydraulic oil and solvents. Since 1986, no materials currently defined as hazardous wastes have been sent to the landfill (DOE 1992). However, the landfill is being regulated as a former hazardous waste disposal site and is currently known as OU 7.

Following the identification of contaminants in landfill leachate in 1973, two ponds were constructed east of the landfill for the purpose of environmental monitoring. In 1981, the more western pond at the landfill was filled to allow eastward expansion. The East Landfill Pond, referred to as the Landfill Pond in this document, is still in existence. The current primary sources of contamination in this pond are leachate generated from the wastes disposed in the landfill and leachate-contaminated groundwater. Secondary possible sources of contamination in the pond include stormwater tributary to the pond and the pond sediments.

Data from SW097 at the western end of the Landfill Pond represent the water quality of the landfill seep which begins at the west end of the landfill and flows directly into the pond. The leachate seep flow is currently estimated to average 3.2 gallons per minute, or approximately 1,700,000 gallons per year (ASI 1991a). The leachate from this seep is potentially a RCRA F039 listed hazardous waste which is expected to be collected, treated, and managed as part of the OU 7 Action Memorandum. This Memorandum is expected to be released in October 1994 and implemented in the summer of 1995. Specific provisions of the Memorandum include installation of a 30-feet wide, 15-feet deep leachate collection system which will be keyed into bedrock at seep SW097. This system will collect both surface and subsurface flows, thereby eliminating the primary source of contaminated influent into the pond (Peterson-Wright 1994). Because this seep is not considered part of this IM/IRA document, data from this seep are not included.

4.2.8 New Spills and Releases

The Site's policy is to reduce to an absolute minimum the instances in which spills and releases of hazardous or radioactive materials occur. Existing programs, including the Chemical Tracking system and the *Spill Prevention Control Countermeasures and Best Management Practices (SPCC/BMP) Plan*, currently address these sources, providing multiple layers of protection. However, it is not possible to reduce the risk of spills and releases to zero. Management of the drainage ponds should consider the possibility of contaminants reaching the ponds as a result of new on-site spills and releases which bypass the multiple layers of protection. It should also be noted that the IA IM/IRA will provide support in monitoring for spills and releases potentially flowing out of the IA, particularly in footing drain and stormwater flows.

Spill events that may affect pond water quality include transportation-related events, tank ruptures, and releases related to D&D and remediation activities. Recent examples of remediation-related releases reaching the ponds include diesel fuel spills and influent water treatment facility pipe leaks at the OU 2 field treatment facility (EG&G 1994c).

4.3 POND WATER QUALITY DATA

There are several major sources of ambient pond water and pond sediment quality data. These include: (1) a current data summary for 1990 through 1994 obtained from Rocky Flats Environmental Database System (RFEDS) (EG&G 1994d); (2) data obtained and evaluated for the C-series ponds during the Phase I RFI/RI for OU 5 (DOE 1994c); (3) data obtained and evaluated for the Landfill Pond as part of the RFI/RI Work Plan for OU 7 (EG&G 1991b); (4) data obtained and evaluated for the A- and B-series ponds during the Phase I RFI/RI for OU 6 (DOE 1994d); and (5) data obtained and evaluated in the *Characterization of the*

Radioactivity in Surface Water and Sediments Collected at the Rocky Flats Facility (LANL 1993). These data are discussed separately below.

4.3.1 RFEDS Pond Water Data Summary (January 1990 through March 1994)

For the purposes of evaluating water quality in the ponds, validated analytical data collected from the ponds during January 1990 to March 1994 were retrieved from RFEDS (EG&G 1994d). These data include ambient in-pond water quality data as well as pre-discharge and discharge samples. Some data gaps exist based on the data available in RFEDS at the time of data retrieval; nonetheless, the RFEDS data are expected to be reflective of pond water quality.

Tables 4-12 through 4-16 contain summary statistics on a pond-by-pond basis for total radionuclides, total metals, dissolved metals, water quality parameters, and organics including volatiles, semi-volatiles, and pesticides. Figures 4-4 through 4-8 contain histograms which graphically depict the number of exceedences of standards for each pond for each analyte group as compared to the total number of samples at each pond.

For purposes of comparison, the 85th percentile value was calculated for each sample population and compared to stream standards where appropriate. The 85th percentile value was obtained by ranking all numeric data available for a given parameter and then converting the ranking to a scale of 1 to 100, and selecting the 85th value.

Overall, the water quality is generally good, especially in terminal A- and B-series ponds. However, interior (spill) ponds show some organic and radionuclide (americium and plutonium) contamination. Pond C-2 also showed elevated gross beta and plutonium-239/-240. The implication of these overall trends is that water leaving plant site via Pond A-4 is generally good. Overall results are discussed by analyte group below.

4.3.1.1 Radionuclides

Summary statistics for the total radionuclides are presented on a pond-by-pond basis in Table 4-12 and depicted graphically in Figure 4-4. Data gaps include the following: Pond A-3 data contain no samples taken after December 1991; Pond C-2 contains no data collected after March 1993; Pond C-1 contains no data between December 1991 and January 1994; and data for Ponds A-1, A-2, B-1, and B-2 are limited to the latter portion of 1991 and the spring of 1992 and a few samples collected in 1993. Although additional data may exist for these dates, they were not yet available on RFEDS. However, visual comparison of these non-RFEDS data to the RFEDS data summary used in this IM/IRA document appear to be generally consistent.

Based on the available data, relatively few exceedances were noted for radionuclides with the exception of gross beta and plutonium-239/ -240 at Pond C-2, plutonium-239/-240 at Ponds B-1 and B-2, and americium-241 at Pond B-1. A few exceedances at several of the ponds were noted for americium-241, gross alpha, gross beta, and tritium. Pond A-3 was the only pond which showed no exceedances for radionuclides. The only analytes with sufficient data to assess trends in concentration over time were gross alpha and gross beta and no noticeable trends were identified.

4.3.1.2 Metals

Summary statistics for total metals are presented in Table 4-13 and depicted graphically in Figure 4-5. The data contain time gaps similar to those for the radionuclides. For total metals, the 85th percentile value for thallium exceeded standards at Ponds A-1 and A-2. Some minor trends in the variation of concentration with time were identified for barium, lithium, magnesium, and sodium. Barium concentrations decreased over time at Ponds A-4 and B-5. Variation of lithium concentration with time at Ponds A-4 and B-5 is characterized by an abrupt increase around November 1991 and then a gradual decline in concentration. Pond C-2 magnesium and sodium concentrations gradually decreased between January 1991 and January 1992, followed by a gradual increase in concentration over the remaining time period.

Summary statistics for the dissolved (filtered) metals are contained in Table 4-14 and depicted graphically in Figure 4-6. The amount of data available for dissolved metals is very similar to that for the total metals. For dissolved metals, the 85th percentile for manganese exceeded stream standards at Ponds A-3, B-5, and C-2. At Pond C-2, the 85th percentile for antimony exceeded the Safe Drinking Water Act (SDWA) maximum contaminant level (MCL) of 6 μg/L. Dissolved metals summaries were not analyzed for the interior ponds. The same trends noticed for the total barium, lithium, magnesium, and sodium data are also evident in the dissolved data for these analytes.

4.3.1.3 Organics

Summary statistics for the organics that have at least one detected sample (at any location) are contained in Table 4-15 and depicted graphically in Figure 4-7. The 85th percentile value exceeded standards for bis(2-ethylhexyl)phthalate at Ponds A-4, B-2, and C-2; for beta BHC at Ponds A-1 and A-2; for alpha BHC at Ponds A-2 and B-2, and for naphthalene at Pond B-2. The pesticide 4,4-DDT was detected in each of the terminal ponds and the PCB Aroclor-1260 was detected once at Pond B-2. Methylene chloride and bis(2-ethylhexyl)phthalate were detected at several of the ponds, but are usually considered to be laboratory contaminants or sampling artifacts. Other organics detected one or two times at one or more ponds included trichloroethene, fluorene, 1,1-dichloroethene, bromodichloromethane, and chloroform. The

Landfill Pond and Pond A-3 had the least number of organic detections, while Pond B-2 contained the largest variety of organic compounds detected.

4.3.1.4 Water Quality Parameters (Inorganics)

Summary statistics for the water quality parameters are contained in Table 4-16 and depicted graphically in Figure 4-8. Some analytes were not sampled at all locations. In particular, samples for several analytes are not available from Ponds A-3 and C-1. The amount of data available over time is similar to that for the dissolved metals. The 85th percentile exceeded stream standards for fluoride at Ponds A-1 and A-2, for ammonia at Ponds A-3, A-4, B-5, and C-2, and for cyanide at Ponds A-4 and B-5, and for nitrite at B-5. Other water quality parameters which were occasionally elevated at some ponds included chloride, sulfide, and sulfate. The ammonia data for Pond A-4 show a cyclical pattern with larger concentrations in about February and lower concentrations in about July. The Pond A-4 results for bicarbonate as calcium carbonate and chloride also show similar patterns.

4.3.2 Pond Water and Pond Sediment Data for Pond C-2

As part of the OU 5 Phase I RFI/RI, the water and sediment quality of the C-series ponds was investigated. This investigation included both recent and historical water quality and sediment data. Results of this investigation are described below.

A comparison of Pond C-1 and Pond C-2 historical water quality data from RFEDS to BUTLs was conducted for the purpose of determining possible contaminants in the ponds. In addition to field and miscellaneous measurements, radionuclides, trace metals and major cations, selected VOCs, SVOCs, pesticides, and herbicides were detected at concentrations higher than detection limits in water samples from Pond C-2 but not necessarily above standards. These included 1,1,1-trichloroethane, acetone, ametryn, atrazine, bis(2-ethylhexyl)phthalate, carbon tetrachloride, methylene chloride, prometon, prometryn, propazine, simazine, simetryn, terbuthylazine, perchloroethylene, toluene, total xylenes, and TCE. Possible contaminants in pond sediments were identified as mercury, barium, and zinc. Further statistical tests are planned as part of OU 5 activities to assess whether these concentrations actually constitute site contaminants or whether uncertainties in both the actual and background data only make it appear that these concentrations can be concluded to be site contaminants. Some of the uncertainties in the historical data include analysis methods, reporting formats, and errors in data reporting (DOE 1994d).

A recent draft study, "Final Report on the Investigation of Plutonium Concentration Fluctuations in Pond C-2," attempts to identify the source of plutonium concentration fluctuations in Pond C-2 which have been observed over the last three years (EG&G 1994e). These fluctuations have occurred on a seasonal basis and have resulted in plutonium concentrations in excess of the WQCC standard of 0.05 pCi/L in some samples collected each summer. Several hypotheses with regard to these seasonal fluctuations are proposed; however, no plausible explanation has yet been identified. Some of the hypotheses initially examined included laboratory error, plutonium fallout, low pond volume, meteorological data, geological parameters, and remediation disturbances associated with the 881 Hillside. Additionally, evaluation of chemical data and thermodynamic considerations have not revealed an easy explanation. However, neither colloidal particles nor adsorbed species on particulates have been rigorously addressed at this time. Chemical parameters including pH, Eh, dissolved oxygen, alkalinity, and various ions and ion pairs have been studied; however, insufficient data are currently available to address the chemical parameters of dissolved organic carbon, total suspended solids/total dissolved solids, and phosphorous which could possibly reveal information about the cause of these fluctuations (EG&G 1994d).

As part of the investigation, field water quality data were collected using Hydrolab portable monitor plot profiles of pH, specific conductance, oxidation-reduction potential, dissolved oxygen, and water temperature with depth for various times of the year. These profiles were used to assess whether and how pond stratification may influence plutonium concentrations in pond water. Analysis of 1994 Hydrolab results for four locations at one foot intervals for Pond C-2 showed: (1) temperature stratification in May; (2) warmer temperatures with less stratification in June; (3) homogeneous temperatures beginning in late July; and (4) elimination of vertical stratification by August 31. During 1990 through 1993, similar results were noted. It may also be possible that fall-turnover may have an effect on plutonium concentrations; however, this effect has not yet been rigorously evaluated (EG&G 1994d).

Concentrations of aquatic life have been assessed due to their influence on dissolved oxygen concentrations. These data indicated a surge in diatom growth in July followed by a population decline prior to the growth of green and blue-green algae in August. Aquatic life may function as adsorption surfaces for plutonium and other transuranics and settle to the bottom as they decompose (EG&G 1994d).

Although correlations have been drawn between various indicators, such as dissolved oxygen, aquatic life activity, and temperature, no explanation of plutonium fluctuations has yet been defined. More study is planned for 1995. Nonetheless, several significant conclusions can be drawn with regard to pond water management for Pond C-2: (1) during the summer months, pond water quality may significantly change within the 30 day time period usually required for laboratory analyses of pond water samples; (2) the summer months are likely times when plutonium concentrations may exceed stream standards; and (3) Pond C-2 is known to contain contaminated sediments which should not be resuspended if possible in order to meet stream standards.

4.3.3 Pond Water and Pond Sediment Quality Data Contained in the OU 6 Phase I RFI/RI Report

Potential COCs were evaluated for several media in OU 6 as part of the OU 6 Phase I RFI/RI. In addition to the previously discussed stream sediments in the Walnut Creek drainage, these COCs included both pond water and pond sediments (DOE 1994a).

Potential COCs for the pond water were selected based on approximately 50 samples collected during the third and fourth quarters of 1992. Five surface water samples were collected from each of the A- and B-series ponds, including the pond at Walnut Creek and Indiana Street. The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, total metals, dissolved metals, dissolved radionuclides, total radionuclides, and the water quality parameters list. These data were then statistically compared to background data reported in the *Background Geochemical Characterization Report* (EG&G 1993a). Radionuclides and analytes above background levels that were detected at 5 percent or greater detection frequency were included in concentration/toxicity screens to select COCs. Compounds detected less than 5 percent of the time were evaluated in the risk-based preliminary remediation goal screen to identify special case COCs. As a result of this work, preliminary COCs selected for the pond water include acetone, chloroform, 1,2-dichloroethene, methylene chloride, and trichloroethene. These COCs will undergo further quantitative risk assessment as part of the HHRA for OU 6 (DOE 1994d). Common laboratory contaminants such as acetone and methylene chloride are not expected to be retained in the final COC list (Holstein 1994).

During the fourth quarter of 1992, 62 sediments from each pond in the A- and B-series ponds were collected at 5 locations each as part of the sitewide surface water program. The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, radionuclides, and the water quality parameters list. Data collected in these sampling activities were then compared to background concentrations for the purposes of determining COCs for the pond sediment. These data were statistically compared to background sediment data. Radionuclides and all other analytes above background limits that were detected at 5 percent or greater detection frequency were included in concentration/toxicity screens with the exception of antimony, which was deemed to be within range of background concentrations. Preliminary COCs for pond sediments were listed as benzo(a)pyrene, benzo(b)flouranthene, bis(2-ethylhexyl)phthalate, Aroclor-1254, antimony, silver, vanadium, zinc, plutonium-239/-240, and americium-241. In addition, chemicals of potential concern that will be evaluated qualitatively in the HHRA include 2-methylnapthalene, benzo(ghi)perylene, phenanthrene, dibenzofuran, and copper; however, these constituents cannot be evaluated in a toxicity or risk-based screen to select chemicals of concern (DOE 1994d). These constituents do not have EPA-established toxicity factors.

4.3.4 Phase I RFI/RI Work Plan for OU 7

As part of the RFI/RI Work Plan for OU 7, COCs were selected based on existing data as of 1991. For surface water, COCs were selected based on data collected in the Landfill Area in the *1989 Surface Water and Sediment Geochemical Characterization Report*. Metals selected as COCs for surface water included beryllium, copper, selenium, strontium, and zinc. Inorganic parameters included cyanide, nitrate, and sulfate. Radionuclide contamination identified for surface water was limited to uranium isotopes detected in water samples collected from the groundwater interceptor system. Organic compounds selected as COCs included 1,1-dichloroethane, 1,1-dichloroethene, 2-butanone, bis(2-ethylhexyl)phthalate, tetrachloroethene, toluene, trichloroethene, vinyl chloride, and total xylenes. The majority of these organic compounds were detected at SW097, which will be addressed as part of OU 7 and is not part of this IM/IRA document; therefore, these organics are not considered COCs for purposes of pond water management at the Site. In addition, the majority of the data for radionuclides, water quality parameters, and metals were also based on surface water sampling locations which will be addressed as part of OU 7 (EG&G, 1991)

4.3.5 Characterization of the Radioactivity in Surface Water and Sediments Collected at the Site

During 1992 and 1993, LANL studied surface waters and sediments collected at the Site for the purpose of characterizing the radioactivity in these media. The study quantified the amount of radioactivity present and determined whether the radioactivity was naturally occurring or anthropogenic. Eighty-three surface water samples were collected and 24 sediment samples were collected and analyzed for radionuclides in support of the project. Waters in the terminal ponds (A-4, B-5, and C-2) and the WWTP effluent were sampled monthly (LANL 1993). Waters in the remaining ponds were sampled quarterly. Major conclusions drawn from the study are as follows:

1. The largest source of anthropogenic radioactivity presently affecting surface waters is the sediments currently residing in the ponds. One gram of sediment from a holding pond contains approximately 50 times more plutonium than 1 liter of water from the pond. Two other specific locations were identified that may affect pond water. Plutonium and depleted uranium, which is low in uranium-235 relative to uranium-238, appear to be moving down the SID and through the A-1 bypass, contributing radioactivity to the water in Pond C-2 and the A-series ponds, respectively (LANL 1993).

2. Ponds A-1, A-2, A-3, B-1, B-2, B-3, and B-4 contain measurable quantities of plutonium, americium, and depleted uranium. The plutonium activities range from 0.004 to 3.09 pCi/L for plutonium-239/-240 and uranium activities range

from 0.2 to 15.8 pCi/L. Essentially all of the uranium in Ponds A-1 and A-2 originated as depleted uranium. All of the other ponds except Pond C-1 contained mixtures of naturally occurring and depleted uranium. No depleted uranium was detected in Pond C-1. Plutonium activities in Pond C-2 appeared to vary seasonally (LANL 1993).

3. The largest source of radioactivity in the terminal ponds was naturally occurring uranium and its decay product radium. There is 70 to 450 times more alpha activity resulting from the decay of naturally occurring radium than alpha activity resulting from plutonium in Ponds A-4, B-5, and C-2 (LANL 1993).

4. The largest source of anthropogenic radioactivity in the terminal ponds was depleted uranium. Approximately half of the uranium present in Ponds A-4 and C-2 originates as depleted uranium. Approximately 20 percent of the uranium in the water collected from Pond B-5 originated as depleted uranium (LANL 1993).

5. The majority of the gross alpha activity detected in pond water for Ponds A-1, A-2, A-3, B-1, and B-2 originated from activities at the Site rather than natural sources. This alpha activity measured in these ponds consisted of uranium and plutonium (LANL 1993).

6. Plutonium activities observed in Ponds A-2, B-1, and B-2 during November 1992 are significantly higher than any other measurements of pond waters. The samples contained a significant quantity of sediments (multiple grams). The sediments in the pond contain more plutonium on a per gram basis than the water. Sediments may be re-suspended by wind or during sampling. The inclusion of sediments in water samples can bias analytical results (LANL 1993).

7. The SID was identified as a possible source of uranium entering Pond C-2. Soil samples collected from the SID showed varying activities of plutonium and depleted uranium, suggesting that those radionuclides were entering the ditch at specific locations. Approximately 50 percent of the uranium detected in the water and 90 percent of the uranium detected in the sediment samples collected from Pond C-2 were anthropogenic. These observations imply that depleted uranium is being transported in water down the SID into Pond C-2 (LANL 1993).

4.3.6 Chemical Profiling of Ponds A-4, B-5, and C-2, 1992

During the summer of 1992, the Surface Water staff obtained vertical profiles for selected water quality parameters in Ponds A-4, B-5, and C-2. The purpose of the study was to establish the degree of vertical variation in water quality in the ponds using the selected chemical parameters of temperature, pH, dissolved oxygen, and redox potential. Variations in these interrelated chemical parameters affect pond water quality through the mobilization of chemical elements, especially metals, whose concentration in the water column is dependent upon pH, dissolved oxygen, and redox potential. In turn, pond operational practices (e.g., filling, discharge, controlled detention storm events) affect these three chemical parameters, and consequently, the concentration of metals (EG&G 1992d).

The study reports that temperature is the primary indicator of stratification in the ponds, and that all three ponds develop some stratification on a routine basis which is persistent during the summer months. Stratification is most pronounced in Pond A-4, least pronounced in Pond C-2, and intermediate in Pond B-5. Temperature differences cause variations in the density of the water column, which contribute to pond stratification. Additions of water to each pond did not change the layering phenomenon but, instead, contributed to additional stratification by essentially making the top layer deeper. Deeper water bodies, such as Pond A-4, stratify more stably than shallower bodies such as Pond C-2, owing to the greater degree of isolation of deeper waters from the actions of wind, which would tend to mix the water column (EG&G 1992d). However, even Pond C-2, which is only 2 to 2.5 meters deep, shows some vertical stratification during early summer months (DOE 1994d). Discontinuities in density or temperature observed in the uppermost 3 to 5 feet of all of the ponds were shown to disappear within a relatively short time (i.e., overnight) (EG&G 1992d).

Dissolved oxygen profiles of Ponds A-4, B-5, and C-2 show a zone of strong oxygen depletion adjacent to the bottom sediments that is seasonally persistent. Because the subsurface layers of these ponds are typically located below the zone of positive net photosynthesis, these layers have no internal oxygen source. Coupled with microbiological activity and sources of chemical oxygen demand, oxygen decline is a standard and persistent phenomenon in the ponds. The zone of oxygen depletion in Pond A-4 was shown to be as much as 10 feet thick, indicating that this layer had been effectively isolated from oxygen sources for a week or more. However, even the shallowest ponds exhibit strong oxygen depletion near the bottom sediments (EG&G 1992d).

Low oxygen concentrations are significant because of the associated water quality implications. As oxygen is reduced in the water column, the oxidation-reduction potential (redox) is reduced drastically. At low redox potentials, some metals (especially iron and manganese) that are bound to sediments or retained in pore waters begin to enter the water column freely and therefore affect water quality. Nutrients, bicarbonate, and organic materials also enter the water column in higher quantities when redox potentials decline (EG&G 1992d).

A separate interpretation of pH and redox potential data is not necessary at this time because these parameters can be predicted in general terms from the oxygen profiles. Where oxygen is abundant, the pH is usually well above 7 in non-montane waters of the Front Range. This is typical of the upper water column in all three of the ponds examined. Where oxygen is strongly depleted, there is a typical noticeable decline of pH. Chemical profiles of the ponds indicate that at the bottom layer of the ponds the pH ranged from a low of 6.5 to 7.0 (EG&G 1992d).

The chemical profiling of the ponds provides information that is critical to the development of pond water management strategies. Because of the certainty of stratification, particularly in the summer, and because stratification is accompanied by reduction in pH and dissolved oxygen concentrations in the ponds, potential release of some metals and other contaminants to the water column should be a major consideration in pond operational strategies. Potentially relevant strategies for managing the dissolved oxygen, pH, and stratification issues include variable pond holding times, reduced pond volumes, improved mixing due to consistent input and discharge of water, or seasonally variable pond water management alternatives.

4.4 POND DISCHARGE DATA

Water quality data collected for pond discharges include sampling required under the NPDES permit and non-regulatory sampling for purposes of water quality characterization.

4.4.1 Historical NPDES Discharge Data

As described previously, discharges from the terminal ponds have been controlled by an NPDES permit since the early 1970s. A summary of recent (1990-1993) NPDES-related data is presented in Table 4-9 (along with WWTP data) and indicates overall compliance with the NPDES permit during these years. Table 4-17 contains a summary of historical exceedances of NPDES permit requirements and water quality problems in the three drainages since 1981. In addition to these exceedances, there were also other NPDES compliance problems such as discharges to ditches and streams at non-permitted discharge points that occurred in 1984 and 1987 (DOE 1992b). Most of these discharge point problems had to do with the operation of spray irrigation fields, which are no longer in operation. The NPDES permit exceedances and water quality problems since 1980 related to water quality problems are discussed below on a drainage specific basis.

4.4.1.1 A-Series Drainage

Water quality exceedances in the A-series drainage ponds have occurred in 1981, 1989, and 1992. In May, June, and July 1981, concentrations of nitrate in excess of the 10 mg/L limit were noted in Pond A-3 and in water flowing into the A-series drainage. These elevated nitrate concentrations were caused by Solar Pond-related contamination that was not effectively collected by a recently built interception system. When modifications to the interception system were made, the elevated nitrate problem was corrected (DOE 1992b). Also in 1981, a release to Pond A-3 occurred from cooling tower cleaning operations; however, no contaminants were identified in the ponds resulting from this release. In 1989, a release occurred from a pump into Pond A-4 (DOE 1992b). In 1992, a diversion of North Walnut Creek water into Pond A-2 was made. Radionuclides from a spill in Building 371 were thought to be present in footing drain water which drained into Pond A-2. However, no contamination flowing from the footing drain was identified, nor was any contamination found in Pond A-2.

4.4.1.2 B-Series Drainage

Water quality issues caused NPDES permit exceedances in the B-series drainage in 1985, 1987, 1988, and 1990. NPDES permit exceedances have not occurred since late 1990.

In 1985, the maximum for total residual chlorine in Pond B-5 was exceeded by accidental discharge of excess WWTP chlorinated effluent to Pond B-3 resulting from a faulty valve. Water from B-3 was later discharged to Pond B-5 (DOE 1986). The faulty valve was repaired. In 1987, a BOD exceedance occurred which was believed to be due to algal growth in Pond B-3 (DOE, 1988). In 1988 and 1990, a number of BOD and fecal coliform exceedances occurred (DOE 1989a; EG&G 1991). The 1988 and 1990 BOD exceedances were later attributed to algal growth in Pond B-3.

In addition to the NPDES permit exceedances, other water quality problems have occurred in the B-series drainage ponds since 1980. In 1989, a release of chromic acid to the WWTP occurred which passed through the WWTP and entered Pond B-3. An extensive sampling effort followed this spill; however, the data from the samples generally indicated that the drainage ponds had chromium concentrations below the drinking water standard of 0.05 mg/L (DOE 1992). Similarly, atrazine, an herbicide, was detected in the B-series ponds. The identification of this herbicide compound in drainage waters at the Site resulted in the purchase and subsequent construction of treatment systems for atrazine at each of the three terminal ponds (DOE 1992). In addition, the use of atrazine at the Site was halted. Concentrations of this herbicide in the B-series drainage ponds has not been identified as a problem in the ponds since that time.

4.4.1.3 C-Series Drainage

Since 1980, there have been no water quality-related NPDES permit exceedances in the C-series drainage. However, in 1989 two separate water quality-related concerns occurred in the C-series drainage.

First, a spill of waste acid may have impacted the SID and Pond C-2 on April 10, 1989 (DOE 1989b). In response to this spill, procedures and physical structures were modified to prevent the recurrence of similar events. Second, measurable concentrations of atrazine were identified in Pond C-2 at the same time as the previously described occurrence in the B-series ponds. Appropriate measures were taken to prevent this occurrence in future operations (DOE 1992).

4.4.1.4 Summary

A number of the water quality issues at the drainage ponds were a result of the presence or possible presence of spilled materials. Although efforts have been made to minimize the possibility of spills occurring at the Site, the probability of spills bypassing multiple layers of protection cannot be reduced to zero. Similarly, other water quality issues were traceable to faulty equipment such as failed valves or pumps. Efforts have been made to minimize the possibility of faulty equipment causing problems. In any event, pond water management alternatives can do little to further decrease water quality problems resulting from spills, faulty equipment, or accidental releases upstream of the ponds. However, pond water management alternatives may be able to address these problems that are apparently caused in the ponds themselves, or in discharges to the ponds over which the Site has control (such as the WWTP discharge).

A pattern can clearly be seen in the NPDES exceedances for the B-series ponds. These exceedances point to a problem with algal blooms, particularly in Pond B-3, and with excessive bacterial counts. In early 1991, the NPDES-FFCA modified the terms of the Site NPDES permit. In particular, the compliance point on WWTP discharges was changed from Pond B-3 to the end of the pipe from the WWTP. Although no NPDES permit exceedances due to algal blooms have been noted since that time, algal blooms are still known to occur in the drainage ponds. Similarly, to address the fecal coliform exceedances, a chlorination/dechlorination step was added to the WWTP operations. NPDES exceedances due to excessive fecal coliform counts have not occurred since the chlorination/dechlorination equipment was added to the WWTP operations. Thus, with the exception of algal blooms, the history of NPDES permit exceedances and pond water quality issues do not indicate a continuing series of water quality problems.

4.4.2 Additional Pond Discharge Data

In addition to compliance-driven discharge monitoring, the Site has also monitored the discharges from Ponds A-4, B-5, C-2, and the Landfill Pond for purposes of characterizing their water quality. Table 4-18 contains a summary of pond discharge data from November 1990 through April 1994 for the ponds. This data set includes some of the data gap time periods identified in the RFEDS summary but also likely duplicates some of the data included in that summary.

While a considerable number of samples with validated data were available for Ponds A-4 and C-2, data for only two samples for Pond B-5 to A-4 transfers were available. Collected samples were analyzed for total recoverable metals, radionuclides, organics, and water quality parameters (Dunstan 1994). Based on comparison of analyte concentrations against Segment 4 stream standards, mean concentrations of antimony, mercury, thallium, ammonia, cyanide, and sulfide exceeded standards for Pond A-4 discharges. In addition to these analytes, the maximum concentrations of gross beta and tritium also exceeded standards for discharges from Pond A-4. For Pond B-5, no analytes exceeded stream standards; however, only limited data were evaluated. For Pond C-2, mean concentrations of gross beta, mercury, thallium, sulfide, and ammonia exceeded stream standards. Maximum concentrations of plutonium-239/-240 and antimony exceeded stream standards. No organic compounds were detected in the discharges from these ponds. Because the mercury data generally do not agree with the RFEDs mercury data, it is expected that the elevated mercury values may be due to high detection limits artificially inflating the mean value. Similarly, the total antimony data do not agree with the RFEDS data.

Once in 1993 and twice in the summer of 1994, transfers of water from the Landfill Pond to the A-series ponds were completed (Pettis 1994). Prior to transfers of water, water quality samples were collected and analyzed. The 1993 transfer data is included in the RFEDS data summary as part of the ambient water quality discussion (EG&G 1994d). The 1994 transfers were not included in the RFEDS data and are also summarized in Table 4-18. The 1994 data indicate that water quality prior to transfer complied with Segment 4 and 5 stream standards. Future transfers of water from the Landfill Pond to the A-series ponds are expected to be limited to the time prior to and during the installation of the leachate collection system in 1995 and special circumstances which may arise after that date.

4.5 CONTAMINANTS OF CONCERN (COCs)

COCs for purposes of monitoring pond water quality were selected based on an evaluation of the background, influent, ambient, and discharge water quality data discussed in this chapter. These COCs have been selected to both adequately characterize ambient pond water quality and to reasonably anticipate constituents that may enter the ponds. The primary function of operational pond monitoring is to ensure that the relevant discharge goals are met prior to water transfer or discharge. An additional goal is to detect anomalous inputs of constituents into the ponds so that the appropriate coordination can occur to identify and more fully characterize contaminant sources. Thus, chemical specific monitoring must be aimed at assessing whether water quality within the ponds meets appropriate discharge goals and whether inputs into the ponds exceed historic levels. This section describes the selection of COCs which will be used to guide the monitoring strategy for the selected pond management alternative.

For the purposes of selecting COCs for the ponds, conclusions from the reports and data sets described in the previous sections are summarized in Tables 4-19 through 4-22 for the A- and B-series ponds, Pond C-2, and the Landfill Pond. Each table is divided into three sections which correspond to influent, ambient, and discharge water quality for each drainage. COCs were selected based on exceedance of WQCC stream standards, when available, and SDWA MCLs or CWA Ambient Water Quality Criteria (AWQC) for the few analytes which do not have stream standards. Because of the interrelationships between the ponds resulting from transfers of water from the B-series ponds and Pond C-2 to Pond A-4, COCs were selected for the pond system as a whole. In the decision-making process, primary emphasis was given to: (1) the RFEDs data summary for each pond; (2) discharge data for each of the terminal ponds; (3) the COCs identified for OU 6; and (4) in the case of Pond C-2; the contaminants identified in the SID. In most cases, the remaining data sources were generally supportive of COCs identified from these four primary data sources. In cases where the potential COCs differed between data sources, professional judgement was used to make a final determination. Table 4-23 contains a summary of COCs selected for the pond system.

For the radionuclides, americium-241, plutonium-239/-240, and tritium were identified as COCs based on elevated concentrations identified in the ponds. Gross alpha and gross beta were also selected as indicators of radionuclide contamination in the ponds. For the A- and B-series ponds, the radionuclide COCs were selected based on either a single maximum discharge value or on data from the interior ponds. For Pond C-2, gross beta and plutonium-239 were selected based on RFEDS data. Based on the LANL (1993) study, a major source of these radionuclides is the pond sediments. This source of radionuclide COCs has strong implications for those pond management alternatives or natural events which could disturb pond sediments. In addition, available stormwater data indicate that contaminated stormwater flows may also contribute radionuclide contamination to the ponds. As previously mentioned, the ponds act as effective settling basins which help to remove radionuclides from the pond water.

For organic compounds, selected COCs include 1,2-dichloroethene, alpha BHC, beta BHC, naphthalene, and trichloroethene. Even though bis(2-ethylhexylphthalate) was detected in concentrations exceeding standards at several ponds, it was not retained as a COC. This decision was made because it is known to be a common sampling artifact and/or laboratory contaminant. In addition, pond sediments are noted to contain PCBs, pesticides, and several SVOCs; however, these constituents were not selected as COCs for pond water because they were not detected in the pond water samples. The source of the majority of the organic COCs is the interior A- and B-series ponds.

For metals, total thallium was identified as a COC in the interior A-series ponds and Pond C-2. Dissolved manganese, antimony, and mercury were also identified as elevated above stream standards; however, they have not been retained as COCs for several reasons. As previously noted, elevated total mercury concentrations identified in the additional discharge data are not consistent with the RFEDs data summary and are expected to be caused by high detection limits. Dissolved manganese concentrations were elevated above Segment 4 stream standards and background concentrations but not Segment 5 stream standards. Antimony concentrations at Pond C-2 were elevated above SDWA MCLs but were within the background range for the Site. In addition, recent statistical and geochemical analyses for groundwater at OU 1 have indicated that elevated concentrations of antimony and manganese are likely due to natural geochemical sources (DOE 1994e). Although thallium has been retained as a COC for purposes of monitoring, it falls within background concentrations and should be further studied to determine whether it should continue to be retained as a monitoring COC. With regard to pond management, alternatives which provide enough detention time for suspended metals to settle out of the water column but do not provide enough time for stratification to occur are favorable.

For inorganic analytes, alkalinity, ammonia, cyanide, fluoride, nitrite, sulfide, and TDS were identified as water quality indicator COCs. With the exception of ammonia and TDS, these varied between pond series. In addition, parameters such as temperature, pH, specific conductance, hardness, dissolved oxygen, and total suspended solids should also be monitored in the ponds because of their potential use as indicators of pond water chemistry and chemical processes.

4.6 CONCLUSIONS

The data and monitoring programs discussed in this chapter provide a basis to select COCs for pond water monitoring purposes. A number of relevant conclusions may also be drawn with regard to sources of contamination in the ponds based on these data and monitoring programs.

1. The chemical sampling data for influent, ambient, and discharge water quality indicate that the pond system plays an important role in beneficially modifying water chemistry prior to discharge. The ponds allow contaminants, such as

plutonium associated with sediments, to settle out of the water column prior to leaving the Site.

2. Potential sources of influent contamination to the ponds include surface water and stormwater flows, sediments contained in these flows, WWTP discharges, footing drain flows, OU treatment unit discharges, groundwater seepage, and new on-site spills. Programs have been or are currently being implemented to control and monitor these potential sources of contamination. However, the historical impacts of these sources may still exist in the ponds (particularly in the upper ponds) in the form of contaminated sediments. In addition, some programs are still in the implementation stage. Even when appropriate preventive measures are taken, new spills, sediment transported by large storm events, and WWTP upsets may continue to be potential sources of contaminants into the ponds.

3. Sitewide surface water and sediment sampling reveals differences in chemical concentrations between the major drainages, indicating that there are different potential sources of contamination for each pond series. For example, the 903 Pad and the SID are two known contaminated areas which influence water quality at Pond C-2.

4. As part of OU 6 RFI/RI activities, several semi-volatile organics, metals, and radionuclides were identified as potential COCs for sediments in the North and South Walnut Creek drainages. Likewise, radionuclide-contaminated sediment transport in the SID contributes to contaminated sediment deposition in Pond C-2. Contaminated sediment transport is expected to be greater at Pond C-2 than at the A- and B-series ponds.

5. Stormwater monitoring programs at the Site have identified several trends in contaminant transport by stormwater flows. For example, runoff from the IA, WWTP discharges, Buffer Zone, and other areas have characteristic chemical signatures which can be used to generally determine the source of contaminants flowing into the ponds. For instance, plutonium-239/-240 tends to be associated with iron-coated aluminosilicate sediments. Comparison of total radionuclide and metals loads upstream and downstream of the A- and B-series ponds shows lower loads downstream of the ponds. This suggests that the ponds are removing constituents from the water column.

6. WWTP upsets and discharges historically have also contributed constituents such as BOD, fecal coliform, and chlorine to the pond system, particularly Pond B-3. However, improvements in WWTP operations appear to have

decreased the opportunity for future impacts. WWTP impacts on the ponds generally increase algal blooms or alter pH. Both of these impacts alter the chemical balance of the ponds and may enhance release of metals to pond water.

7. Footing drain flows and discharges from OU treatment units are two sources of contaminants which are being addressed as part of the OUs. Monitoring, collection, and treatment of contaminated footing drain flows as part of OU 8 activities is expected to reduce the possible impact of footing drain flows on pond water quality. Current discharges from OU 1 and 2 treatment systems do not appear to contribute to contamination at the ponds.

8. Groundwater flows into the ponds, or into drainages tributary to the ponds, may also be a source of contamination. Only limited studies have been conducted on the interaction between ground and surface water. The majority of these studies focus on the Woman Creek area. Some recent data suggest that VOC contamination at Pond B-2 may be due to groundwater seepage through the alluvial materials into the pond.

9. Based on influent, ambient and discharge water quality data reviewed in this chapter, several radionuclides, organics, metals, and water quality parameters have been identified as COCs for monitoring purposes at the ponds. A summary of these analytes is contained in Table 4-23. In general, the interior ponds showed more contamination than the terminal ponds, with the exception of gross beta and plutonium-239/-240 at Pond C-2.

10. The largest source of anthropogenic radioactivity presently affecting the ponds was identified by a 1993 LANL study as contaminated sediments. Based on the partitioning coefficient for plutonium, these sediments act as a sink to remove plutonium from pond water. Pond management alternatives should not resuspend these sediments.

11. Excluding the landfill seep at SW097, the water quality in the Landfill Pond generally meets Segment 4 and 5 stream standards. Transfers of Landfill Pond water to the A-series ponds in the future are expected to be limited to the time period associated with construction of the leachate collection system in the summer of 1995 and special circumstances.

12. Chemical profiles of the ponds indicate that stratification of pond waters occurs. This stratification is strongest in the summer and is accompanied by reduction of pH and dissolved oxygen near the bottom of the water column. These conditions may contribute to release of some metals and other contaminants

from sediments to the lower water column. Potentially relevant strategies for managing dissolved oxygen, pH, and stratification issues include variable pond holding times, in-pond agitation, or seasonally variable pond water management practices.

13. Although discharges from the terminal ponds have met the requirements of the NPDES-FFCA permit, discharge water quality has, in some instances, exceeded Segment 4 stream standards for some constituents. The few exceedances of the NPDES permit appear to have resulted from the impacts of the WWTP effluent in conjunction with in-pond processes which caused elevated concentrations of BOD, fecal coliform, and total residual chlorine. Exceedances of Segment 4 standards during the 1990s have included mean concentrations of gross beta, antimony, thallium, ammonia, cyanide, and sulfide. It is important to note that radionuclides have not generally exceeded stream standards, emphasizing the role that the ponds play in settling contaminants out of the water column. Exceedances for metals in pond discharges may be a result of sediment remobilization, in-pond water chemistry fluctuations resulting from variations in dissolved oxygen, and pH or high flow conditions resulting from stormwater influent.

Based on the COCs selected and the conclusions drawn in this chapter, several recommendations with regard to pond water management are appropriate. Pond water management strategies should: (1) incorporate adequate holding times, which allow sediments to settle out; (2) avoid disturbance and resuspension of pond sediments; and (3) employ practices which inhibit stratification and stagnation of the pond water. It is also recommended that COCs be reevaluated on a quarterly basis to assess changes in water quality and the effectiveness of pond water management practices.

Finally, new data and conclusions from ongoing Surface Water programs such as the event-related stormwater program should be integrated with pond water management practices. For example, estimates of sediment loads transported by stormwater to the ponds and evaluation of seasonal variations in the pond water quality are pertinent to pond management. Monitoring programs and studies associated with the IA and OUs 5 and 6 should also be integrated where appropriate.

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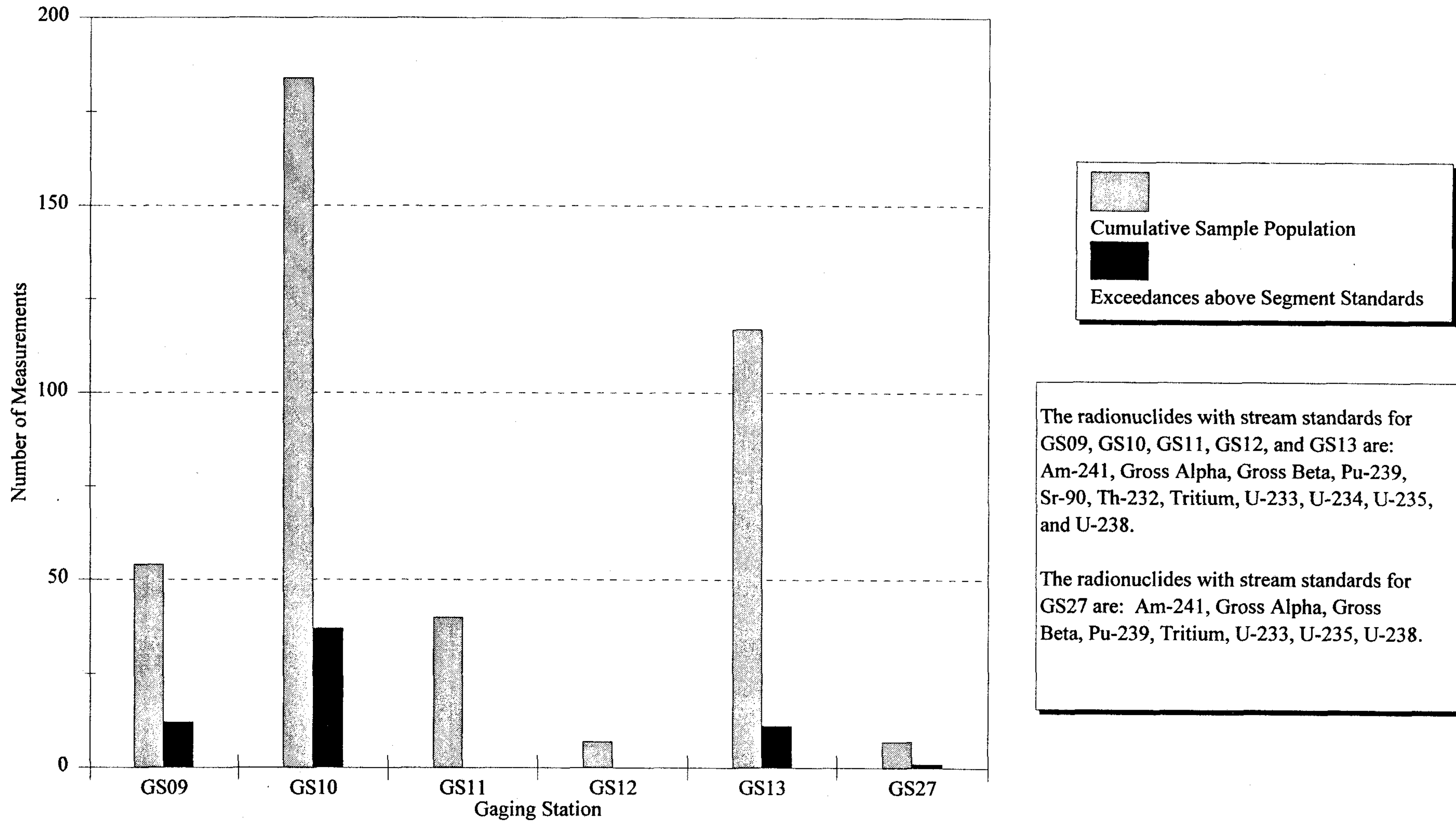
Figure 4-3: Stormwater Exceedances

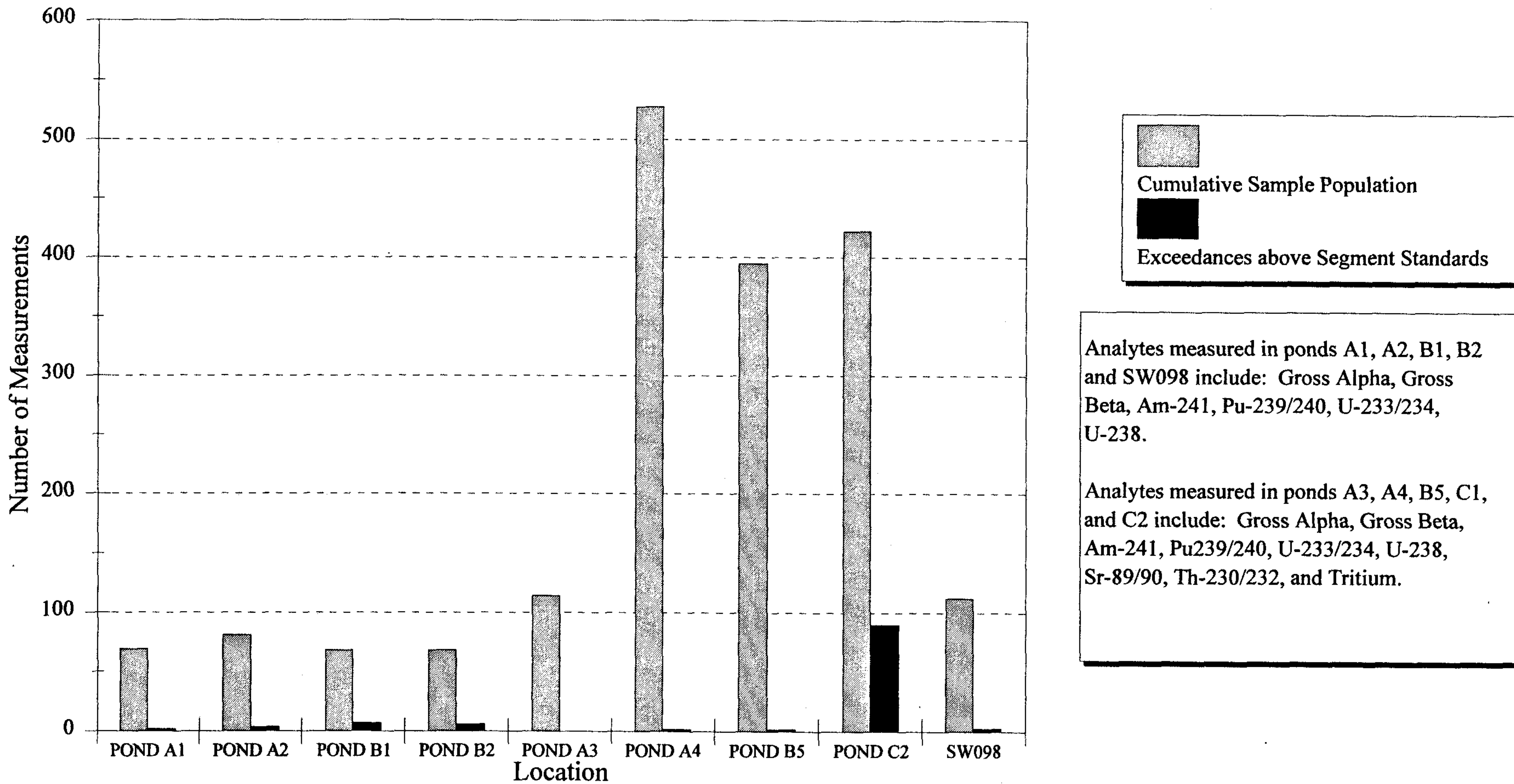
Radionuclides



The radionuclides with stream standards for GS09, GS10, GS11, GS12, and GS13 are: Am-241, Gross Alpha, Gross Beta, Pu-239, Sr-90, Th-232, Tritium, U-233, U-234, U-235, and U-238.

The radionuclides with stream standards for GS27 are: Am-241, Gross Alpha, Gross Beta, Pu-239, Tritium, U-233, U-235, U-238.

Figure 4-4: Exceedances Report
Radionuclides



Analytes measured in ponds A1, A2, B1, B2 and SW098 include: Gross Alpha, Gross Beta, Am-241, Pu-239/240, U-233/234, U-238.

Analytes measured in ponds A3, A4, B5, C1, and C2 include: Gross Alpha, Gross Beta, Am-241, Pu239/240, U-233/234, U-238, Sr-89/90, Th-230/232, and Tritium.

Figure 4-5: Exceedances Report

Total Metals

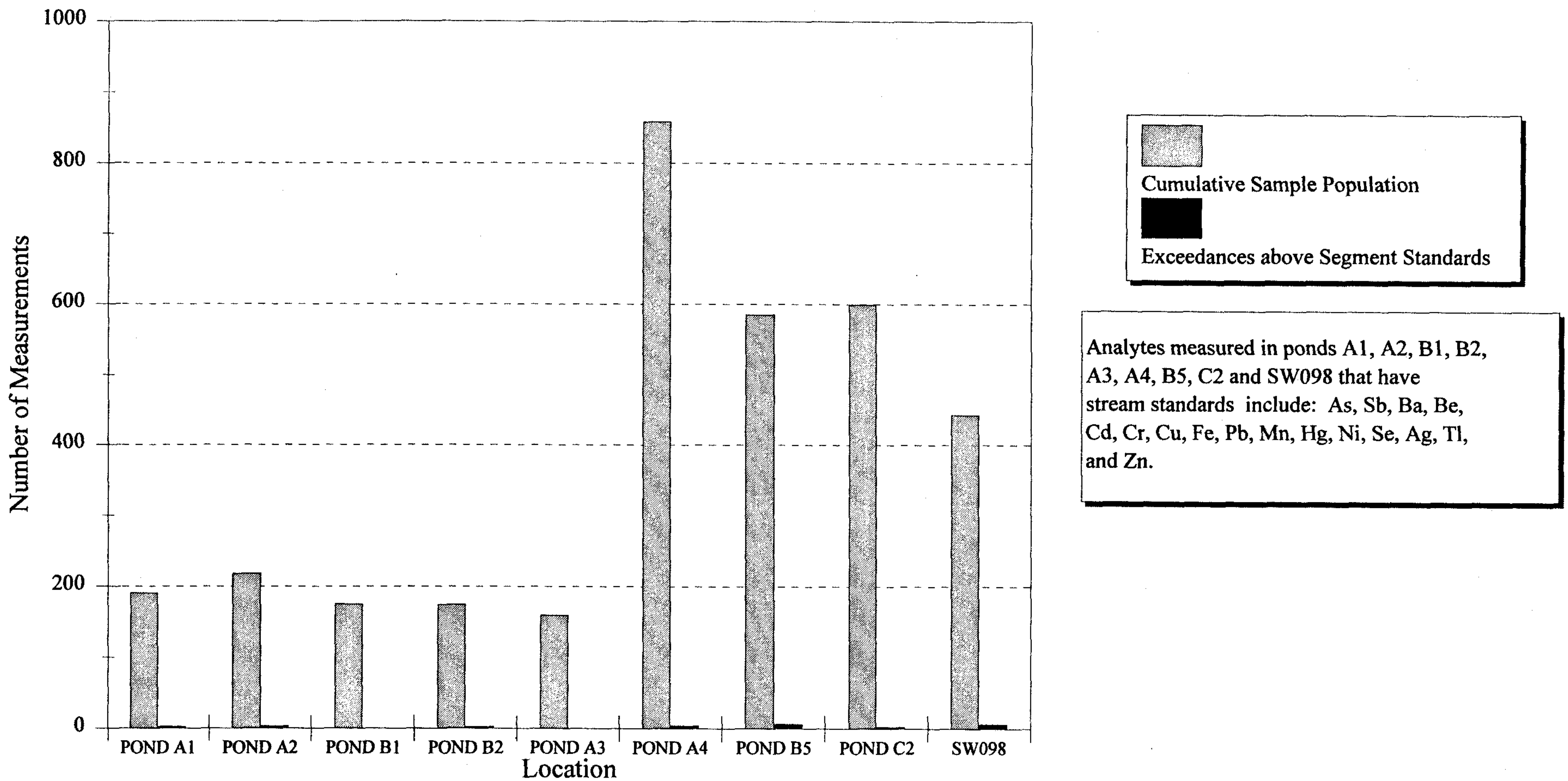
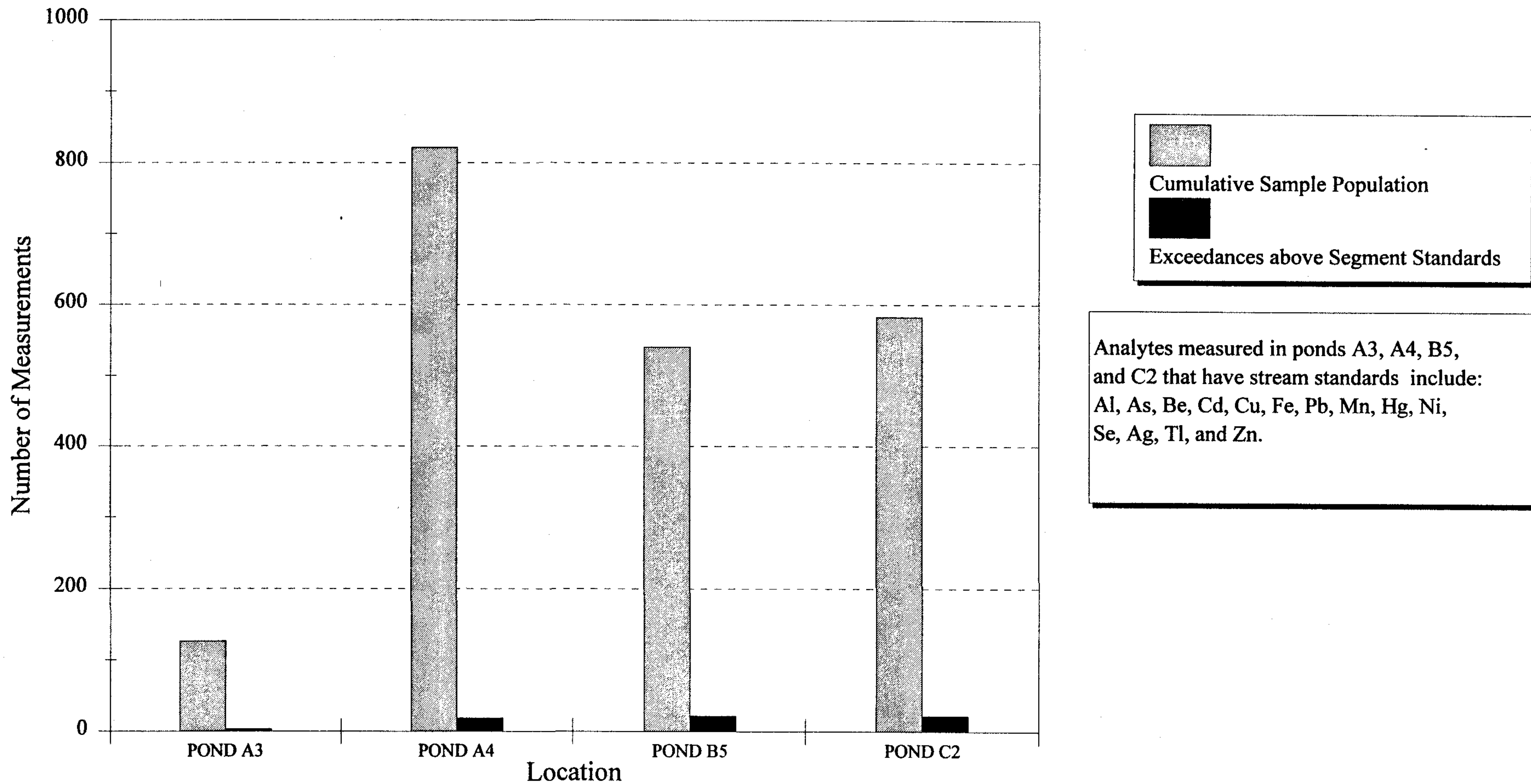


Figure 4-6: Exceedances Report

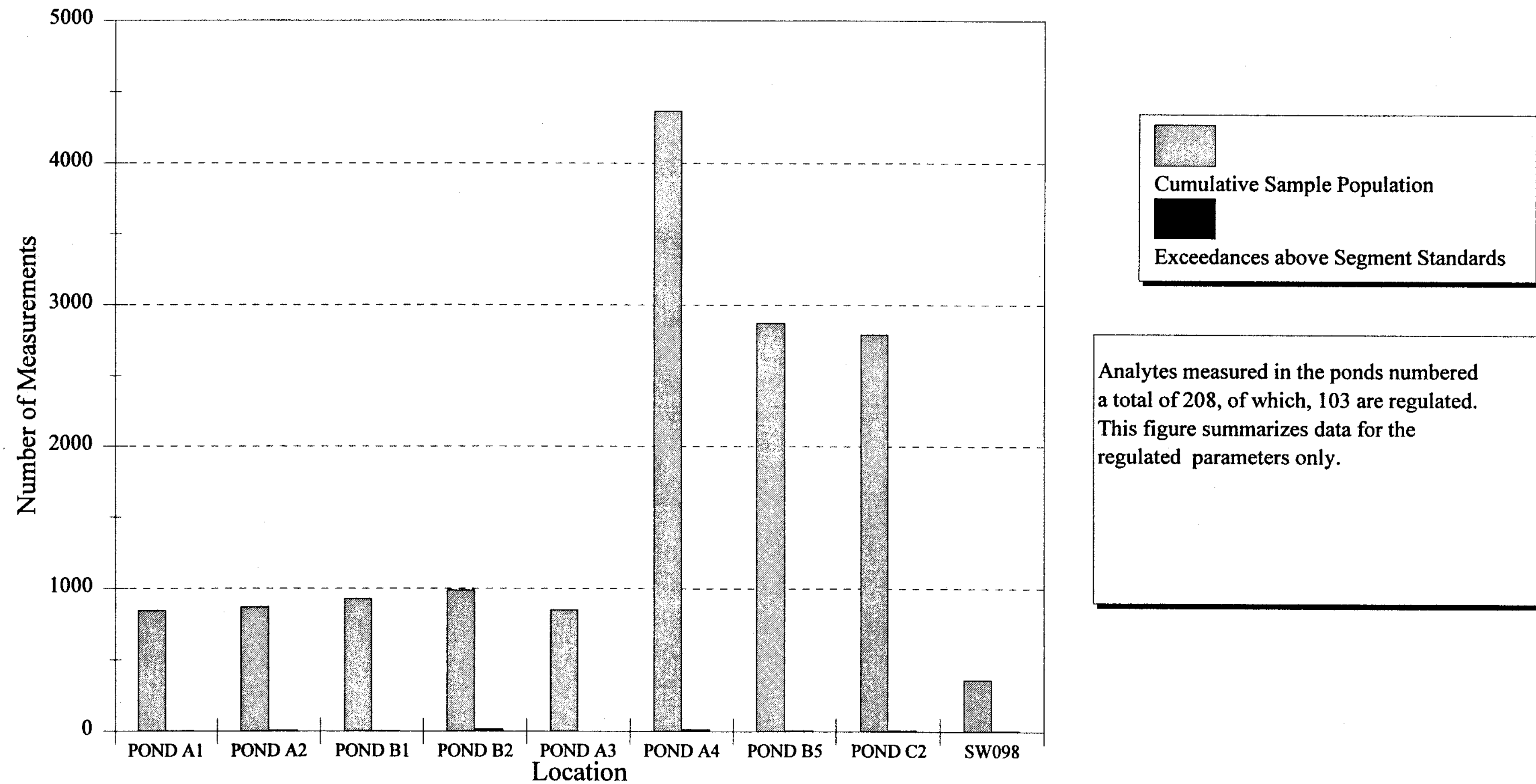
Dissolved Metals



Analytes measured in ponds A3, A4, B5, and C2 that have stream standards include: Al, As, Be, Cd, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ag, Tl, and Zn.

Figure 4-7: Exceedances Report

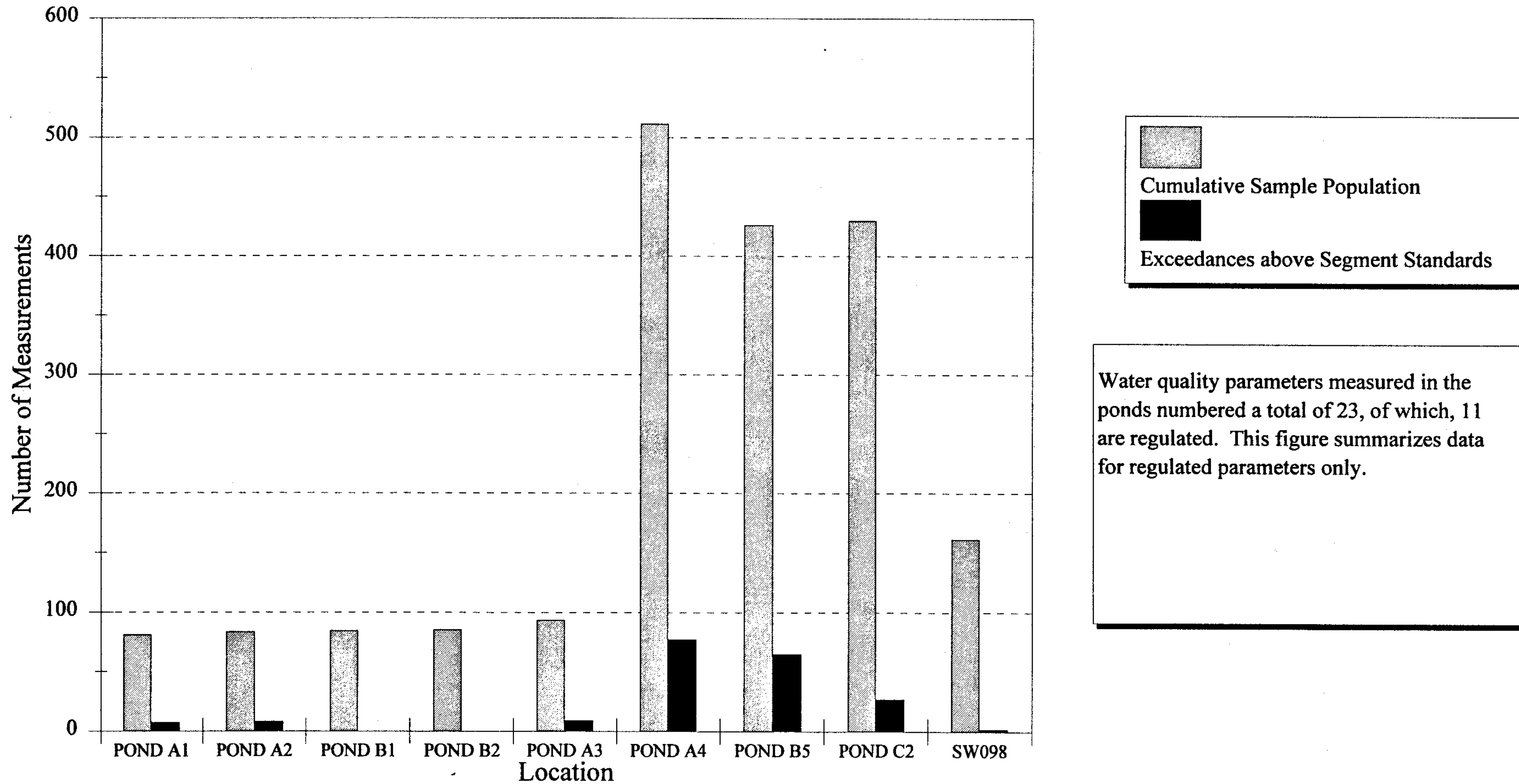
VOA/SVOA, Herbicides, & Pesticides



Analytes measured in the ponds numbered a total of 208, of which, 103 are regulated. This figure summarizes data for the regulated parameters only.

Figure 4-8: Exceedances Report

Water Quality Parameters



Water quality parameters measured in the ponds numbered a total of 23, of which, 11 are regulated. This figure summarizes data for regulated parameters only.

TABLE 4-1
1989 SURFACE-WATER AND SEDIMENT MONITORING STATIONS BY OU OR AREA

881 Hillside Area (881)

SW045
SW046

903 Pad Area (903)

SW050
SW053
SW055
SW058
SW065
SW077

Solar Ponds Area (SP)

SW084	SW092
SW085	SW093
SW086	SW094
SW087	SW095
SW088	SW105
SW089	SW106
SW090	

Landfill Area (LF)

SW097
SW098
SW099
SW100

Upper South Walnut Creek (USWC)

SW022	
SW023	
SW056	
SW060	
SW061	SED011
SW101	

Upper South Interceptor Ditch (USID)

SW035
SW036

Lower South Interceptor Ditch (LSID)

SW027	SED025
SW030	SED028
SW031	
SW044	
SW054	SED029
SW066	
SW067	
SW068	
SW069	
SW070	

Woman Creek (WC)

SW028	SED026
SW029	SED027
SW032	
SW033	
SW034	
SW062	SED030

SW = Surface Water Station

SED = Sediment Station

TABLE 4-2
1989 SURFACE WATER AND SEDIMENT GEOCHEMICAL CHARACTERIZATION REPORT DATA

PARAMETER	Upper Tolerance Limits (1)	Source Of Standard (2)	Standard (3)	LOCATION AND DATA YEAR (4) Landfill (1989)				Upper South Walnut Creek (1989)				Lower South Interceptor Ditch (1989)			
				Average	Maximum	Std. Deviation	Sample Size	Average	Maximum	Std. Deviation	Sample Size	Average	Maximum	Std. Deviation	Sample Size
TOTAL RADIONUCLIDES (pCi/L)															
Americium-241	0.02	WQCC (4/5)/DCG	0.05/30	0.02	0.33	0.07	20	0.120	1.3	0.253	30	0.044	0.320	0.078	47
Cesium-137	NA	NA	NA												
Gross alpha	28.06	WQCC (4/5)	7*/11**	25.24	210.00	56.45	21	66.35	780.0	152.72	31	14.18	230.00	33.20	48
Gross beta	30.35	WQCC (4/5)	5*/19**	36.88	310.00	67.22	21	51.36	570.0	116.98	31	15.14	140.00	22.60	48
Plutonium-239	0.02	WQCC (4/5)/DCG	0.05/30					0.397	3.3	0.876	32	0.160	3.700	0.571	47
Radium-226	16.56	WQCC (SW)	5	3.03	13.00	4.53	8	1.922	7.2	2.260	18	0.755	5.700	1.376	33
Strontium-90	4.88	WQCC (SW)	8	0.79	2.21	0.56	23	0.193	2.2	0.499	32				
Tritium	711.94	WQCC (4/5)/DCG	500/1000					100.63	500.0	196.76	32				
Uranium, Total	2.69	WQCC (4/5)	5*/10**	7.78	40.70	11.36	17	5.65	16.60	3.37	25	6.93	18.80	3.45	30
Uranium-233, -234 (5)	2.16	WQCC (4/5)/DCG	(5*/10**)/500	3.34	22.00	5.40	23	2.92	7.70	1.70	32	3.21	8.30	1.70	48
Uranium-235 (5)	0.28	WQCC (4/5)	5*/10**	0.11	0.70	0.19	23	0.17	1.00	0.19	32	0.16	0.60	0.16	48
Uranium-238 (5)	1.73	WQCC (4/5)	5*/10**	2.85	18.00	4.48	23	2.52	7.90	1.42	32	3.71	13.00	2.21	48
VOLATILE ORGANICS (µg/L)															
1,1-Dichloroethane	NA	NA	NA	3.45	8.00	1.77	21	4.689	50	8.030	37				
1,1-Dichloroethene	NA	WQCC (SW)	0.057	5.29	61.00	12.77	21								
2-Butanone	NA	NA	NA	6.10	16.00	2.96	21								
4-methyl-2-pentanone	NA	NA	NA	5.76	15.00	3.00	21								
Acetone	NA	NA	NA					12.897	130	25.540	29				
Benzene	NA	WQCC (SW)	1.000	6.26	83.00	17.59	21								
Carbon tetrachloride	NA	WQCC (5)	18					46.861	430	95.466	36				
Chlorobenzene	NA	WQCC (SW)	100	6.86	94.00	19.97	21								
Chloroethane	NA	NA	NA	6.45	20.00	3.97	20								
Chloroform	NA	WQCC (SW)	6					18.417	82	23.630	36	2.799	27	2.903	72
Ethylbenzene	NA	WQCC (SW)	680	4.21	12.00	3.13	21					2.535	5	0.295	72
Methylene Chloride	NA	WQCC (SW)	4.7	6.45	15.00	5.16	10	3.280	11	2.020	25	3.133	11	1.875	30
Tetrachloroethene	NA	WQCC (SW)	76					53.095	280	83.694	37				
Total Xylenes	NA	NA	NA	3.57	13.00	2.99	21								
Trichloroethene	NA	WQCC (SW)	66	7.07	92.00	19.58	21	41.040	260	62.500	37	2.708	16	1.598	72
Vinyl chloride	NA	WQCC (SW)	2					7.135	25	5.056	37				
SEMI-VOLATILE ORGANICS (µg/L)								(None Detected during 1989 monitoring)							
2-methylnapthalene	NA	NA	NA	7.00	15.00	3.83	7								
4-methylphenol	NA	NA	NA	13.71	43.00	15.76	7								
Bis[2-ethylhexyl]-phthalate	NA	WQCC (SW)	1.8									12.852	220	41.449	27
Phenol	NA	WQCC (SW)	2560	6.43	18.00	5.22	7								
TOTAL RECOVERABLE METALS (mg/L)															
Copper		WQCC (5)	0.023					0.0252	0.293	0.055	26				
Iron		WQCC (5)	13.2	28.64	131.00	40.86	20	8.8	204	36.58	31	5.8	57.1	13.7492	70
Lead		WQCC (5)	0.028	0.02	0.16	0.04	19	0.013	0.215	0.038	31	0.011	0.0744	0.0194	64
Zinc		WQCC (5)	0.35	1.49	6.05	2.16	20	0.275	1.19	0.0287	31	0.136	0.784	0.1977	64
DISSOLVED METALS (mg/L)															
Aluminum	0.48	WQCC (SW)	0.087	0.32	4.52	0.99	20								
Antimony	0.06	NA	NA												
Barium	0.13	NA	NA	0.30	0.82	0.27	21	0.136	0.244	0.499	33	0.101	0.250	0.020	85
Beryllium	NA	WQCC (4/5)	0.004	0.00	0.01	0.00	19	0.002	0.005	0.001	29				
Cadmium	NA	WQCC (4/5)	0.0015												
Calcium	50.36	NA	NA	138.17	503.00	118.86	21	83.81	133.00	37.75	33	64.76	111.00	15.922	85
Copper	0.02	WQCC (4/5)	0.0160	0.02	0.04	0.01	17	0.013	0.029	0.003	27	0.014	0.047	0.007	80
Iron	0.56	WQCC (4/5)	0.3	20.37	69.70	27.51	20					0.091	1.350	0.169	76
Lead	0.01	WQCC (4/5)	0.006									0.004	0.114	0.013	77
Lithium	0.06	NA	NA	0.05	0.10	0.02	21					0.04	0.09	0.02	85
Magnesium	9.80	NA	NA	38.90	64.40	12.36	21	15.98	29.10	7.18	33	15.60	51.80	6.37	85
Manganese	0.14	WQCC (5)	0.560	0.87	2.92	0.99	20	0.109	0.701	0.210	33	0.068	1.180	0.165	84
Potassium	3.59	NA	NA	10.24	50.40	11.04	20	2.21	2.50	0.60	29	3.10	14.30	1.92	80
Selenium	0.01	WQCC (SW chr)	0.017	0.03	0.55	0.13	17					0.003	0.013	0.008	70
Sodium	34.10	NA	NA	108.70	204.00	58.01	21	32.02	60.00	15.03	33	35.86	110.00	15.71	85
Strontium	0.97	NA	NA	0.93	2.64	0.58	21	0.52	1.17	0.19	31	0.48	1.17	0.13	85
Zinc	0.06	WQCC (4/5)	0.144	0.87	3.36	1.29	21	0.130	0.626	0.142	31	0.033	1.110	0.130	72
WATER QUALITY (mg/L)															
Specific Conductivity (umhos/cm)	NA	NA	NA	1,888.90	5,000.00	1,264.12	27	740	1,428	370	48	695	1,195	212	94
Dissolved Oxygen	NA	WQCC (4/5)	5.00	3.99	11.70	3.33	27	6.60	70.00	9.82	48	5.02	16.70	3.56	94
Field pH	9.32	WQCC (4/5)	6.5-9.0	7.28	9.00	0.20	27	7.5	8.5	0.7	48	7.9	9.2	0.7	94
Total Dissolved Solids (TDS)	302.28	WQCC (SW)	250	1,291.11	11,000.00	2,081.08	27	422.0	3,300.0	451.6	51	377.4	720.0	94.0	93
Total Suspended Solids (TSS)	27,293.0	NA	NA	416.85	5,300.00	1,114.33	27								
Bicarbonate	191.32	NA	NA	497.56	900.00	240.62	27	283.4	540.0	159.8	51	220.2	580.0	74.7	93
Chloride	53.20	WQCC (4/5)	250	153.57	660.00	150.06	27	36.4	81.0	19.8	51	55.5	150.0	16.2	93
Nitrate	NA	WQCC (4/5)	10.0	4.87	70.83	16.19	19	12.8	24.8	7.5	35	9.4	32.3	6.3	57
Nitrate/Nitrite	1.35	WQCC (4/5)	10.0	0.82	16.00	3.08	27	3.0	5.6	1.7	51	2.7	7.4	1.6	93
Sulfate	37.83	WQCC (4/5)	250	170.07	1,900.00	420.70	27	42.9	74.0	17.1	51	54.0	130.0	17.3	93

Data Sources:

EG&G, 1992. Adapted from 1989 Surface Water And Sediment Geochemical Characterization Report. Final. April, 1, 1992.

Table Notes:

(1) Upper Tolerance Limits were taken from the 1993 Background Geochemical Characterization Report (EG&G, 1993).

(2) Sources of standards are: (1) WQCC Water Quality Standards for Big Dry Creek Basin, Segments 4 and 5 (4/5); (2) WQCC Segment 5 Temporary modifications; (2) statewide WQCC standards (WQCC SW); and (3) DOE derived concentration guides (DCGs) for selected radionuclides."NA" indicates that a standard or BUTL is not available. Chronic values were used when both acute and chronic standards were available.

(3) "/" provides values for WQCC/DCG standards so that values can be compared to both standards. * indicates Woman Creek Value and ** indicates Walnut Creek value.

(4) Location and year are provided to identify data summarized for three general areas and the year the data was collected.

(5)Total uranium standard is 5 pCi/L so uranium-233, -234, -235, -236 and -238 must not exceed 5 pCi/L either together or individually.

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TABLE 4-3

GROUPING OF SURFACE WATER SAMPLING LOCATIONS FOR AREAS OF THE ROCKY FLATS PLANT USED IN THE 1990 SURFACE WATER AND SEDIMENT GEOCHEMICAL CHARACTERIZATION REPORT

AREA OF THE RFP	SURFACE-WATER STATION NUMBER							
Background	SW004	SW005	SW006	SW007	SW080	SW083	SW104	SW107
	SW108	SW127	SW130	SW131	SW042			
South Walnut Creek	SW121	SW122	SW123	SW056	SW101	SW059	SW060	SW061
	SW023	SW025	SW103					
Landfill	SW096	SW097	SW098	SW099	SW100	SW014		
North Walnut Creek	SW116	SW117	SW118	SW093	SW017	SW092	SW016	SW015
	SW128							
Solar Pond	SW085	SW087	SW088	SW089	SW090	SW105	SW106	SW091
	SW094	SW095						
South Intercepter Ditch	SW038	SW129	SW036	SW035	SW044	SW031	SW066	SW067
	SW068	SW069	SW070	SW030	SW054	SW027		
OU1 and OU2	SW051	SW052	SW053	SW057	SW055	SW058	SW077	SW071
	SW072	SW125	SW045	SW046	SW126	SW065	SW064	SW050
Woman Creek	SW032	SW033	SW034	SW029	SW028	SW026	SW001	SW002
	SW062	SW041	SW039					
Northwest Protected Area	SW043	SW018	SW124	SW084	SW086	SW102	SW120	SW119

TABLE 4-4
1990 SURFACE WATER AND SEDIMENT GEOCHEMICAL CHARACTERIZATION REPORT DATA

PARAMETER	Upper Tolerance Limits (1)	Source Of Standard (2)	Standard (3)	LOCATION AND DATA YEAR (4) Landfill (1990) Average	Landfill (1990) Std. Deviation	Landfill (1990) Sample Size	North Walnut Creek (1990) Average	North Walnut Creek (1990) Std. Deviation	North Walnut Creek (1990) Sample Size	South Walnut Creek (1990) Average	South Walnut Creek (1990) Std. Deviation	South Walnut Creek (1990) Sample Size	Lower South Interceptor Ditch (1990) Average	Lower South Interceptor Ditch (1990) Std. Deviation	Lower South Interceptor Ditch (1990) Sample Size
TOTAL RADIONUCLIDES (pCi/L)															
Americium-241	0.02	WQCC (4/5)/DCG	0.05/30	0.009	0.008	5	0.133	0.377	10	0.068	0.151	28	0.009	0.015	43
Cesium-137	NA	NA	NA	(0.010)	0.127	5	-0.034	0.138	10	0.131	0.792	30	0.163	0.404	49
Gross alpha	28.06	WQCC (4/5)	7/11	1.341	0.334	3	4.559	2.565	8	4.452	3.396	24	4.780	5.397	39
Gross beta	30.35	WQCC (4/5)	5/19	5.407	3.322	3	9.897	1.486	8	5.612	3.499	24	6.469	4.231	39
Plutonium-239	0.02	WQCC (4/5)/DCG	0.05/30	0.004	0.002	5	0.012	0.015	10	0.022	0.058	30	0.020	0.057	49
Strontium-90	4.88	WQCC (SW)	8	0.564	0.028	3	0.467	0.170	8	0.406	0.851	24	0.393	0.562	38
Tritium	711.94	WQCC (4/5)/DCG	500/1000	300.412	126.450	2	204.930	78.665	8	146.321	157.882	22	158.728	180.926	38
Uranium-233, -234 (5)	2.16	WQCC (4/5)/DCG	(5/10)/500	1.006	1.112	3	4.130	3.930	8	3.122	2.503	24	2.338	0.964	37
Uranium-235 (5)	0.28	WQCC (4/5)	5/10	0.021	0.036	3	0.251	0.210	8	0.207	0.235	24	0.122	0.109	37
Uranium-238 (5)	1.73	WQCC (4/5)	5/10	0.681	0.988	3	5.759	3.418	8	2.624	2.071	24	2.626	2.187	37
TOTAL RECOVERABLE METALS (mg/L)															
Zinc		WQCC (5)	0.35	0.001	0.001	23	0.044	0.036	40	0.255	0.348	52	0.073	0.079	108
WATER QUALITY (mg/L)															
Total Suspended Solids (TSS)	27,293.0	NA	NA	270.000	683.000	17	26.080	48.468	34	152.760	365.862	50	52.382	102.454	68
Nitrate/Nitrite	1.35	WQCC (4/5)	10.0	0.165	0.217	17	2.203	2.691	32	2.911	1.588	46	2.263	1.719	61
Sulfate	37.83	WQCC (4/5)	250												

Data Sources:

EG&G, 1992. Adapted from 1990 Surface Water And Sediment Geochemical Characterization Report. Final. March 17, 1992.

Table Notes:

(1) Upper Tolerance Limits were taken from the 1993 Background Geochemical Characterization Report (EG&G, 1993).

(2) Sources of standards are: (1) WQCC Water Quality Standards for Big Dry Creek Basin, Segments 4 and 5 (4/5); (2) WQCC Segment 5 Temporary modifications; (2) statewide WQCC standards (WQCC SW); and (3) DOE derived concentration guides (DCGs) for selected radionuclides."NA" indicates that a standard or BUTL is not available. Chronic values were used when both acute and chronic standards were available.

(3) "/" provides values for WQCC/DCG standards so that values can be compared to both standards. * indicates Woman Creek Value and ** indicates Walnut Creek value.

(4) Location and year are provided to identify data summarized for three general areas and the year the data was collected.

(5)Total uranium standard is 5 pCi/L so uranium-233, -234, -235, -236 and -238 must not exceed 5 pCi/L either together or individually.

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Table 4-5
Rocky Flats Stormwater Quality Data Summary
Water Years 1991-1993

PARAMETER	GS09							GS10						
Dissolved Metals [µg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**
ALUMINUM	6	68.8	35.8	52.50	6	0	87	18	4450	19	312.11	17	5	87
ANTIMONY	6	29	23	24.00	6	6	6	18	33	23	24.67	18	18	6
ARSENIC	6	90	64	68.33	6	0	150	18	90	2.8	58.69	18	0	150
BARIUM	6	36.7	11.5	22.72	6	0	1000	18	87.4	1	42.70	18	0	1000
BERYLLIUM	6	1	1	1.00	6	0	4	18	1	1	1.00	18	0	4
CADMIUM	6	5	4	4.83	6	6	1.5	18	5	3	4.72	18	18	1.5
CALCIUM	6	36900	23300	29233.33	0	0		18	63300	330	27502.50	1	0	
CESIUM	0				0	0		2	617	617	617.00	2	0	
CHROMIUM	6	8	4	7.33	6	0	50	18	11.4	3	7.79	17	0	50
COBALT	6	8	5	7.50	6	0		18	8	5	7.55	18	0	
COPPER	6	13	3	5.30	6	0	16	18	26.3	3	9.44	17	2	16
IRON	6	36.7	15.9	25.35	6	0	300	18	6000	5.2	387.29	15	1	300
LEAD	6	75	47	70.33	6	6	6.46	18	286	2	98.22	16	17	6.46
LITHIUM	6	9.2	2	4.63	6	0		18	10.3	1	4.54	18	0	
MAGNESIUM	6	6780	3710	4918.33	4	0		18	11800	44	5046.33	8	0	
MANGANESE	6	25.7	2.2	13.78	3	0	560	18	458	1	60.60	7	0	560
MERCURY	0				0	0	0.01	4	0.2	0.2	0.20	4	4	0.01
MOLYBDENUM	6	11	9	9.33	6	0		18	15	9	10.01	18	0	
NICKEL	6	15	12	14.50	6	0	125	18	15	12	14.61	18	0	125
POTASSIUM	6	12700	4760	6748.33	2	0		18	4410	575	2647.72	18	0	
SELENIUM	6	48	41	42.17	6	6	17	18	48	2	37.06	18	16	17
SILICON	5	6720	2390	3892.00	0	0		17	9960	110	2621.00	0	0	
SILVER	6	6	5	5.83	6	6	0.59	18	6	4	5.72	18	18	0.59
SODIUM	6	37300	15200	22216.67	0	0		18	41900	332	18862.22	2	0	
STRONTIUM	6	177	120	145.83	6	0		18	381	1	171.56	12	0	
THALLIUM	6	191	127	180.33	6	6	15	18	191	3	166.56	18	16	15
TIN	6	21	10	19.17	6	0		18	21	10	19.17	18	0	
VANADIUM	6	18.1	7	11.52	6	0		18	14.1	5	10.62	18	0	
ZINC	6	17.3	7.7	14.15	6	0	144	18	313	5.3	42.72	12	1	144
	GS09							GS10						
Total Metals [µg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**
ALUMINUM	9	14100	1030	5660.00	0	0		31	26000	19	8616.09	5	0	
ANTIMONY	9	30	9.9	24.54	9	8	14	31	33	6.9	21.23	31	23	14
ARSENIC	9	94	2.4	53.16	8	6	50	31	90	0.35	37.01	22	16	50
BARIUM	9	138	20.1	66.56	8	0	1000	31	367	1	116.07	18	0	1000
BERYLLIUM***	9	2.5	1	1.37	8	9	4	31	2.6	0.3	1.14	28	31	4
CADMIUM	9	5	1.15	3.68	9	0	10	29	5	1.15	3.53	28	0	10
CALCIUM	9	37300	16600	30155.56	0	0		31	83300	330	37064.35	2	0	
CESIUM	1	250	250	250.00	1	0		14	617	250	356.00	14	0	
CHROMIUM	9	18.8	5	9.77	6	0	50	31	34.5	2.75	13.81	11	0	50
COBALT	9	25	4	10.41	8	0		31	25	1.35	7.64	25	0	
COPPER	9	27.4	4.8	14.69	7	2	23	31	69.2	3	26.23	10	16	23
IRON	9	14800	686	5681.56	0	1	13200	31	35300	11	9116.92	4	6	13200
LEAD	9	286	22.3	126.12	7	8	28	31	286	0.4	135.32	19	19	28
LITHIUM	9	50	4.8	17.03	8	0		31	50	1	11.26	20	0	
MAGNESIUM	9	7990	2500	5586.67	3	0		31	21800	44	7964.32	7	0	
MANGANESE	9	358	42.5	149.34	0	0	1000	31	1370	1	338.28	5	2	1000
MERCURY	3	0.1	0.1	0.10	3	3	2	14	0.3	0.1	0.14	12	14	2
MOLYBDENUM	9	100	4.5	28.83	8	0		31	100	1.75	11.85	27	0	

Table 4-5 (Continued)
Rocky Flats Stormwater Quality Data Summary
Water Years 1991-1993

	GS09							GS10						
Total Metals [µg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**
NICKEL	9	20	5.6	14.62	9	0	200	31	35.2	5.35	14.24	24	0	200
POTASSIUM	9	11700	2500	6424.44	2	0		31	6750	575	3905.45	15	0	
SELENIUM	9	48	0.35	30.15	9	6	10	29	48	0.35	23.92	29	16	10
SILICON	7	7330	0	2444.71	0	0		27	9960	0	1710.11	1	0	
SILVER	9	7	2.4	5.27	8	0	50	30	8.8	1.05	4.81	26	0	50
SODIUM	9	35600	7770	19696.67	0	0		31	55000	343	20582.61	3	0	
STRONTIUM	6	192	126	154.83	6	0		18	433	1	192.83	11	0	
THALLIUM	9	191	0.9	105.66	8	9	0.012	31	191	0.45	93.39	30	31	0.012
TIN	9	100	10	34.47	8	0		31	100	4.7	22.92	30	0	
VANADIUM	6	20.9	7	12.13	6	0		18	59.2	5	23.38	16	0	
ZINC	9	306	37.4	138.14	0	0	350	31	1190	7	331.90	4	12	350

	GS09						GS10					
Radionuclides [pCi/L]	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**
AMERICIUM-241	8	0.24	-0.021	0.08	6	0.05	22	0.45	-0.003075	0.15	16	0.05
CESIUM-137	1	0.72	0.72	0.72	0		8	0.34	0.024	0.14	0	
CURIUM-244	1	0.008	0.008	0.01	0		3	0.016	-0.004	0.01	0	
GROSS ALPHA	7	7	0	3.34	0	11	23	25	1.8	7.55	4	11
GROSS BETA	7	21.46	6	13.16	1	19	22	21.5	2	10.34	3	19
NEPTUNIUM-237	1	0.025	0.025	0.03	0		3	0	-0.009	0.00	0	
PLUTONIUM-239	8	0.125	0.028	0.07	5	0.05	28	0.58	0.005	0.12	13	0.05
RADIUM-226	0				0	5	2	0.47	0.38	0.43	0	5
RADIUM-228	0				0	5	1	2.7	2.7	2.70	0	5
STRONTIUM-89	1	0.4	0.4	0.40	0		7	0.42	-0.74	0.07	0	
STRONTIUM-90	0				0	8	1	0.27	0.27	0.27	0	8
THORIUM-232	1	0.73	0.73	0.73	0	60	3	0.91	0.19	0.59	0	60
TRITIUM	2	0	-72	-36.00	0	500	11	276.3	-150	31.34	0	500
URANIUM-233	5	0.547	0.1435	0.30	0	10	15	55	0.26	4.27	1	10
URANIUM-234	0				0	10	0				0	10
URANIUM-235	8	0.034	-0.01	0.01	0	10	28	0.29	-0.044	0.04	0	10
URANIUM-238	8	0.66	0.081	0.33	0	10	28	2.222	0.072	0.85	0	10

	GS09						GS10					
Water Quality [mg/L]	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**
ALKALINITY	5	112.7	39.5	70.64	0		14	116	43.6	68.32	0	
CARBONATE	5	0	0	0.00	0		15	10	0	0.67	0	
CHLORIDE	5	29.4	0.91	18.36	0	250	15	44.5	12.9	20.95	0	250
CONDUCTIVITY	5	578	301	406.00	0		14	674	190	359.93	0	
FLUORIDE	5	40.8	0.5	8.61	1	2	15	2.5	0.23	0.75	1	2
NITRATE	3	2.26	1.88	2.08	0	10	12	4.56	1.03	1.84	0	10
pH	5	7.5	6.8	7.20	0	6.5-9.0	14	7.9	6.51	7.13	0	6.5-9.0
SULFATE	5	58.6	5.3	34.54	0	250	15	121	14.3	50.09	0	250
TOTAL DISSOLVED SOLIDS	5	319	185	226.60	1	250	15	440	132	225.80	5	250
TOTAL SUSPENDED SOLIDS	5	160	28	88.80	0		15	550	13	194.47	0	

Source: EG&G, 1994. Event-Related Surface Water and Sediment Sampling Data for Water Years 1991-1993. Provided by Greg Wetherbee, EG&G, Surface Water Division.

* The test method used for metals analyses was inductively coupled plasma emissions spectroscopy (ICPES), unless otherwise noted. This test method has relatively high detection limits; therefore, the majority of exceedances noted are due to artificially inflated values calculated based on one-half of the method detection limit (MDL).

** No value is presented for those analytes without WQCC numeric standards.

*** The site-specific WQCC standard for dissolved beryllium was also used for total beryllium because no site-specific total beryllium standard exists.

Table 4-5 (Continued)
Rocky Flats Stormwater Quality Data Summary
Water Years 1991-1993

PARAMETER	GS12							GS13						
Dissolved Metals [µg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**
ALUMINUM				No Data Available				10	120	28.3	62.79	10	2	87
ANTIMONY				No Data Available				10	29	23	23.60	10	10	6
ARSENIC				No Data Available				10	90	64	66.60	10	0	150
BARIUM				No Data Available				10	93.3	30.3	48.29	10	0	1000
BERYLLIUM				No Data Available				10	1	1	1.00	10	0	4
CADMIUM				No Data Available				10	5	4	4.90	10	10	1.5
CALCIUM				No Data Available				10	75900	19200	34040.00	0	0	
CESIUM				No Data Available				0				0	0	
CHROMIUM				No Data Available				10	8	4.5	7.65	10	0	50
COBALT				No Data Available				10	8	5	7.70	10	0	
COPPER				No Data Available				10	9.3	3	5.70	10	0	16
IRON				No Data Available				10	82.7	27.5	57.77	10	0	300
LEAD				No Data Available				10	75	47	72.20	10	10	6.46
LITHIUM				No Data Available				10	16.8	2.6	5.24	10	0	
MAGNESIUM				No Data Available				10	23100	3990	7980.00	2	0	
MANGANESE				No Data Available				10	32.4	1.6	15.03	4	0	560
MERCURY				No Data Available				0				0	0	0.01
MOLYBDENUM				No Data Available				10	11	9	9.20	10	0	
NICKEL				No Data Available				10	15	12	14.70	10	0	125
POTASSIUM				No Data Available				10	5730	2300	3733.00	8	0	
SELENIUM				No Data Available				10	48	41	41.70	10	10	17
SILICON				No Data Available				9	6960	2360	3602.22	0	0	
SILVER				No Data Available				10	6	5	5.90	10	10	0.59
SODIUM				No Data Available				10	52000	13300	21490.00	0	0	
STRONTIUM				No Data Available				10	591	119	225.90	6	0	
THALLIUM				No Data Available				10	191	127	184.60	10	10	15
TIN				No Data Available				10	21	10	19.90	10	0	
VANADIUM				No Data Available				10	11	7	10.60	10	0	
ZINC				No Data Available				10	10.7	4.7	7.27	9	0	144
	GS12							GS13						
Total Metals [µg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**
ALUMINUM	1	673	673	673.00	0	0		21	33000	67.3	8277.87	1	0	
ANTIMONY	1	30	30	30.00	1	1	14	19	30	6.9	21.99	19	16	14
ARSENIC	1	5	5	5.00	1	0	50	20	94	0.35	37.30	14	10	50
BARIUM	1	100	100	100.00	1	0	1000	21	280	52.9	115.92	10	0	1000
BERYLLIUM***	1	2.5	2.5	2.50	1	1	4	19	2.8	0.3	1.24	17	19	4
CADMIUM	1	2.5	2.5	2.50	1	0	10	17	40	1.2	5.67	17	1	10
CALCIUM	1	37700	37700	37700.00	0	0		21	82100	22700	39419.05	0	0	
CESIUM	1	500	500	500.00	1	0		9	500	50	283.33	9	0	
CHROMIUM	1	5	5	5.00	1	0	50	20	35	2.75	10.53	13	0	50
COBALT	1	25	25	25.00	1	0		19	25	1.8	7.16	16	0	
COPPER	1	12.5	12.5	12.50	1	0	23	21	38	2.7	14.31	12	2	23
IRON	1	686	686	686.00	0	0	13200	21	33000	77.8	7811.75	1	4	13200
LEAD	1	2.5	2.5	2.50	1	0	28	21	286	0.4	112.85	10	12	28
LITHIUM	1	50	50	50.00	1	0		21	23	4.8	10.71	10	0	
MAGNESIUM	1	8990	8990	8990.00	0	0		21	21600	5220	9634.29	0	0	
MANGANESE	1	157	157	157.00	0	0	1000	21	950	10	243.96	1	0	1000
MERCURY	1	0.1	0.1	0.10	1	0	2	9	1.1	0.1	0.26	8	0	2
MOLYBDENUM	1	100	100	100.00	1	0		19	25	2.9	10.41	19	0	
NICKEL	1	20	20	20.00	1	0	200	19	29	2.95	14.57	16	0	200
POTASSIUM	1	2500	2500	2500.00	1	0		21	8100	2260	4520.95	6	0	

Table 4-5 (Continued)
Rocky Flats Stormwater Quality Data Summary
Water Years 1991-1993

	GS12							GS13						
Total Metals [µg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL*	Exceeds	Standard**
SELENIUM	1	2.5	2.5	2.50	1	0	10	19	48	0.6	23.25	18	10	10
SILICON	1	0	0	0.00	0	0		20	7490	0	2091.50	0	0	
SILVER	1	5	5	5.00	1	0	50	20	7	1.45	4.84	20	0	50
SODIUM	1	27600	27600	27600.00	0	0		21	49800	13500	24609.52	0	0	
STRONTIUM	0				0	0		10	572	141	234.90	5	0	
THALLIUM	1	5	5	5.00	1	1	0.012	20	191	0.7	85.68	20	20	0.012
TIN	1	100	100	100.00	1	0		18	100	5.2	27.54	18	0	
VANADIUM	0				0	0		10	18.7	7	11.11	10	0	
ZINC	1	10	10	10.00	1	0	350	21	340	3.6	93.96	2	0	350

	GS12						GS13					
Radionuclides [pCi/L]	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**
AMERICIUM-241	1	0.011	0.011	0.01	0	0.05	10	0.093	0.002	0.04	4	0.05
CESIUM-137	0				0		10	0.28	-0.095	0.08	0	
CURIUM-244	0				0		3	0.028	-0.012	0.01	0	
GROSS ALPHA	1	2.71	2.71	2.71	0	11	16	7	-0.37	4.06	0	11
GROSS BETA	1	8.5	8.5	8.50	0	19	14	10	0.63	5.90	0	19
NEPTUNIUM-237	0				0		2	0.041	0.018	0.03	0	
PLUTONIUM-239	1	0.012	0.012	0.01	0	0.05	18	0.285	-0.003	0.06	7	0.05
RADIUM-226	0				0	5	2	0.16	0.11	0.14	0	5
RADIUM-228	0				0	5	1	1.4	1.4	1.40	0	5
STRONTIUM-89	0				0		11	0.65	-0.069	0.33	0	
STRONTIUM-90	0				0	8	1	0.39	0.39	0.39	0	8
THORIUM-232	0				0	60	3	0.69	0.01	0.28	0	60
TRITIUM	1	147.1	147.1	147.10	0	500	8	140.55	-21	84.98	0	500
URANIUM-233	0					10	7	2.773	0.499	0.99	0	10
URANIUM-234	0				0	10	1	1.1	1.1	1.10	0	10
URANIUM-235	1	0.09522	0.09522	0.10	0	10	18	0.44	-0.005	0.08	0	10
URANIUM-238	1	1.4	1.4	1.40	0	10	18	4.9	0.442	1.81	0	10

	GS12						GS13					
Water Quality [mg/L]	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**
ALKALINITY	No Data Available						7	246.6	65.2	106.84	0	
CARBONATE	No Data Available						7	7.7	0	1.10	0	
CHLORIDE	No Data Available						7	49.6	16.6	26.44	0	250
CONDUCTIVITY	No Data Available						7	766	216	362.00	0	
FLUORIDE	No Data Available						7	0.94	0.5	0.65	0	2
NITRATE	No Data Available						5	1.39	0.78	0.97	0	10
pH	No Data Available						7	7.9	6.9	7.43	0	6.5-9.0
SULFATE	No Data Available						7	53.1	13.1	23.86	0	250
TOTAL DISSOLVED SOLIDS	No Data Available						7	469	157	241.00	1	250
TOTAL SUSPENDED SOLIDS	No Data Available						7	233	4	83.00	0	

Source: EG&G, 1994. Event-Related Surface Water and Sediment Sampling Data for Water Years 1991-1993. Provided by Greg Wetherbee, EG&G, Surface Water Division.

* The test method used for metals analyses was inductively coupled plasma emissions spectroscopy (ICPES), unless otherwise noted. This test method has relatively high detection limits; therefore, the majority of exceedances noted are due to artificially inflated values calculated based on one-half of the method detection limit (MDL).

** No value is presented for those analytes without WQCC numeric standards.

*** The site-specific WQCC standard for dissolved beryllium was also used for total beryllium because no site-specific total beryllium standard exists.

Table 4-5 (Continued)
Rocky Flats Stormwater Quality Data Summary
Water Years 1991-1993

PARAMETER	GS11							GS27						
Dissolved Metals [μg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**
ALUMINUM	1	29.1	29.1	29.10	1	0	87	1	65.1	65.1	65.10	1	0	87
ANTIMONY	1	23	23	23.00	1	1	6	1	23	23	23.00	1	1	6
ARSENIC	1	64	64	64.00	1	0	150	1	64	64	64.00	1	0	150
BARIUM	1	56.9	56.9	56.90	1	0	1000	1	64	64	64.00	1	0	1000
BERYLLIUM	1	1	1	1.00	1	0	4	1	1	1	1.00	1	0	4
CADMIUM	1	5	5	5.00	1	1	1.5	1	5	5	5.00	1	1	1.5
CALCIUM	1	38400	38400	38400.00	0	0		1	118000	118000	118000.00	0	0	
CESIUM	0				0	0		0				0	0	
CHROMIUM	1	8	8	8.00	1	0	50	1	8	8	8.00	1	0	50
COBALT	1	8	8	8.00	1	0		1	8	8	8.00	1	0	
COPPER	1	3.1	3.1	3.10	1	0	16	1	3.9	3.9	3.90	1	0	16
IRON	1	7.1	7.1	7.10	1	0	300	1	20.2	20.2	20.20	1	0	300
LEAD	1	286	286	286.00	1	1	6.46	1	75	75	75.00	1	1	6.46
LITHIUM	1	9.5	9.5	9.50	1	0		1	15.2	15.2	15.20	1	0	
MAGNESIUM	1	9570	9570	9570.00	0	0		1	16200	16200	16200.00	0	0	
MANGANESE	1	1	1	1.00	1	0	50	1	5.8	5.8	5.80	1	0	560
MERCURY	0				0	0	0.01	0				0	0	0.01
MOLYBDENUM	1	9	9	9.00	1	0		1	9	9	9.00	1	0	
NICKEL	1	15	15	15.00	1	0	125	1	15.2	15.2	15.20	1	0	125
POTASSIUM	1	7520	7520	7520.00	0	0		1	2720	2720	2720.00	1	0	
SELENIUM	1	41	41	41.00	1	1	17	1	41	41	41.00	1	1	17
SILICON	1	3730	3730	3730.00	0	0		1	4740	4740	4740.00	0	0	
SILVER	1	6	6	6.00	1	1	0.59	1	6	6	6.00	1	1	0.59
SODIUM	1	40000	40000	40000.00	0	0		1	34100	34100	34100.00	0	0	
STRONTIUM	1	262	262	262.00	0	0		1	575	575	575.00	0	0	
THALLIUM	1	191	191	191.00	1	1	15	1	191	191	191.00	1	1	15
TIN	1	21	21	21.00	1	0		1	21	21	21.00	1	0	
VANADIUM	1	11	11	11.00	1	0		1	11	11	11.00	1	0	
ZINC	1	11.6	11.6	11.60	1	0	144	1	9.8	9.8	9.80	1	0	144
	GS11							GS27						
Total Metals [μg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**
ALUMINUM	6	540	100	321.50	1	0		1	67.4	67.4	67.40	1	0	
ANTIMONY	6	30	9.9	19.78	6	3	14	1	23	23	23.00	1	1	14
ARSENIC	4	95.3	0.8	26.53	3	1	50	1	64	64	64.00	1	1	50
BARIUM	6	100	70	85.37	3	0	1000	1	61.6	61.6	61.60	1	0	1000
BERYLLIUM***	6	2.5	0.3	1.15	6	6	4	1	1	1	1.00	1	1	4
CADMIUM	6	4	1.15	2.08	6	0	10	1	5	5	5.00	1	0	10
CALCIUM	6	48100	40900	45183.33	0	0		1	117000	117000	117000.00	0	0	
CESIUM	4	500	250	312.50	4	0		0				0	0	
CHROMIUM	6	5	1	2.83	6	0	50	1	8	8	8.00	1	0	50
COBALT	6	25	1.35	9.84	6	0		1	8	8	8.00	1	0	
COPPER	6	12.5	1.15	6.08	5	0	200	1	6	6	6.00	1	0	23
IRON	6	474	156	285.17	0	0	1000	1	23.1	23.1	23.10	1	0	13200
LEAD	5	47	0.45	10.58	5	0	50	1	286	286	286.00	1	1	28
LITHIUM	6	50	8.3	23.85	3	0		1	15.2	15.2	15.20	1	0	
MAGNESIUM	6	12000	9170	10676.67	0	0		1	15300	15300	15300.00	0	0	
MANGANESE	6	399	116	180.50	0	0	1000	1	9.6	9.6	9.60	1	0	1000
MERCURY	5	0.1	0.1	0.10	5	5	2	0				0	0	2

Table 4-5 (Continued)
Rocky Flats Stormwater Quality Data Summary
Water Years 1991-1993

	GS11							GS27						
Total Metals [µg/L]*	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**
MOLYBDENUM	6	100	4.2	37.63	3	0		1	9	9	9.00	1	0	
NICKEL	6	20	5.6	11.47	6	0	200	1	15	15	15.00	1	0	200
POTASSIUM	6	8920	6590	7466.67	0	0		1	2560	2560	2560.00	1	0	
SELENIUM	6	48	0.35	9.01	6	1	10	1	41	41	41.00	1	1	10
SILICON	5	0	0	0.00	0	0		1	3760	3760	3760.00	0	0	
SILVER	6	5	1.05	3.03	6	0	50	1	6	6	6.00	1	0	50
SODIUM	6	41500	32700	39083.33	0	0		1	33700	33700	33700.00	0	0	
STRONTIUM	1	265	265	265.00	0	0		1	557	557	557.00	0	0	
THALLIUM	6	127	0.45	23.06	6	6	0.012	1	191	191	191.00	1	1	0.012
TIN	6	100	4.7	40.00	4	0		1	21	21	21.00	1	0	
VANADIUM	1	7	7	7.00	1	0		1	11	11	11.00	1	0	
ZINC	6	14.2	9	10.83	3	0	2000	1	9.1	9.1	9.10	1	0	350
	GS11							GS27						
Radionuclides [pCi/L]	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**		Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**	
AMERICIUM-241	5	0.01	-0.001	0.01	0	0.05		1	-0.005	-0.005	-0.01	0	0.05	
CESIUM-137	1	-0.11	-0.11	-0.11	0									
CURIUM-244	2	0.001	0.001	0.00	0									
GROSS ALPHA	5	4.3	1.78	2.92	0	11		1	8	8	8.00	1	7	
GROSS BETA	5	14.72	7.8	10.24	0	19		1	5	5	5.00	0	5	
NEPTUNIUM-237	3	0.081	-0.006	0.05	0									
PLUTONIUM-239	5	0.026	-0.001	0.01	0	0.05		1	-0.004	-0.004	0.00	0	0.05	
RADIUM-226	0				0	5								
RADIUM-228	0				0	5								
STRONTIUM-89	3	0.27	0.13	0.20	0									
STRONTIUM-90	0				0	8								
THORIUM-232	2	0	0	0.00	0	60								
TRITIUM	5	99	-2.4	26.47	0	500		0				0	500	
URANIUM-233	1	0.937	0.937	0.94	0	10		1	3.359	3.359	3.36	0	5	
URANIUM-234	0				0	10								
URANIUM-235	6	2.453	-0.12	0.43	0	10		1	0.115	0.115	0.12	0	5	
URANIUM-238	6	1.7	0.106	1.01	0	10		1	3.437	3.437	3.44	0	5	
	GS11							GS27						
Water Quality [mg/L]	Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**		Sample #	Max Value	Min Value	Avg Value	Exceeds	Standard**	
ALKALINITY	1	87	87	87.00	0			1	123	123	123.00	0		
BICARBONATE	1	87	87	87.00	0			1	123	123	123.00	0		
CARBONATE	1	0	0	0.00	0			1	0	0	0.00	0		
CHLORIDE	1	43.1	43.1	43.10	0	250		1	25	25	25.00	0	250	
CONDUCTIVITY	1	505	505	505.00	0			1	833	833	833.00	0		
FLUORIDE	1	5.6	5.6	5.60	1	2		1	1.02	1.02	1.02	0	2	
NITRATE	1	1.6	1.6	1.60	0	10		0				0	10	
pH	1	8.1	8.1	8.10	0	6.5-9.0		1	7.6	7.6	7.60	0	6.5-9.0	
SULFATE	1	63.5	63.5	63.50	0	250		1	240	240	240.00	0	250	
TOTAL DISSOLVED SOLIDS	1	301	301	301.00	1	250		1	594	594	594.00	1	250	
TOTAL SUSPENDED SOLIDS	1	26	26	26.00	0			1	6	6	6.00	0		

Source: EG&G, 1994. Event-Related Surface Water and Sediment Sampling Data for Water Years 1991-1993. Provided by Greg Wetherbee, EG&G, Surface Water Division.

* The test method used for metals analyses was inductively coupled plasma emissions spectroscopy (ICPES), unless otherwise noted. This test method has relatively high detection limits; therefore, the majority of exceedances noted are due to artificially inflated values calculated based on one-half of the method detection limit (MDL).

*** The site-specific WQCC standard for dissolved beryllium was also used for total beryllium because no site-specific total beryllium standard exists.

*** The site-specific WQCC standard for dissolved beryllium was also used for total beryllium because no site-specific total beryllium standard exists.

Table 4-6
Rocky Flats Stormwater Quality Data Summary
Water Year 1993 - ICPM Results*

PARAMETER	GS09							GS10						
Dissolved Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**
ANTIMONY	1	33	33	33.00	0	1	6	2	71	59	65.00	1	2	6
CESIUM	5	5	1	1.80	5	0		13	5	1	2.54	13	0	
LEAD	4	179	1	46.50	3	1	6.46	11	142	1	25.18	9	2	6.46
THALLIUM	5	5	1	1.80	5	0	15	13	5	1	2.54	13	0	15
URANIUM	4	12	1	3.75	3	0		10	296	1	98.60	2	0	
	GS09							GS10						
Total Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**
ANTIMONY	1	12	12	12.00	0	0	14	2	29	25	27.00	0	2	14
CESIUM	5	5	1	1.80	0	0		13	147	1	24.77	0	0	
LEAD	4	887	79	336.50	0	4	28	11	2624	8	822.09	0	10	28
THALLIUM	5	5	1	1.80	0	5	0.012	13	5	1	2.54	0	13	0.012
URANIUM	4	122	1	35.75	0	0		10	377	15	168.00	0	0	
	GS11							GS13						
Dissolved Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**
ANTIMONY								1	26	26	26.00	0	1	6
CESIUM	1	5	5	5.00	1	0		6	5	1	1.67	6	0	
LEAD	1	5	5	5.00	1	0	6.46	5	5	1	1.80	4	0	6.46
THALLIUM	1	5	5	5.00	1	0	15	6	5	1	1.67	6	0	15
URANIUM	1	22	22	22.00	0	0		4	1244	132	532.50	0	0	
	GS11							GS13						
Total Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard**
ANTIMONY								1	1	1	1.00	0	0	14
CESIUM	1	5	5	5.00	0	0		6	5	1	1.67	0	0	
LEAD	1	11	11	11.00	0	0	50	5	1192	88	481.60	0	5	28
THALLIUM	1	5	5	5.00	0	1	0.012	6	5	1	1.67	0	6	0.012
URANIUM	1	36	36	36.00	0	0		4	1226	24	514.75	0	0	

Source: EG&G, 1994. Event-Related Surface Water and Sediment Sampling Data for Water Year 1993. Provided by Greg Wetherbee, EG&G, Surface Water Division.

* ICPMS is Inductively Coupled Plasma Mass Spectrometry.

** MDL = method detection limit. No value is presented for those analytes without numeric standards

Table 4-7
Rocky Flats Stormwater Quality Data Summary
Water Year 1993 - GFAA Results*

PARAMETER	GS09							GS10						
Dissolved Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard
ARSENIC	6	452	2	145.50	6	2	150	15	539	1	134.47	15	4	150
LEAD	2	1	1	1.00	2	0	6.46	5	1	1	1.00	5	0	6.46
MERCURY	6	0.2	0.2	0.20	6	6	0.01	15	0.2	0.2	0.20	15	15	0.01
SELENIUM	6	13	1	4.67	6	0	17	15	19	1	6.00	15	3	17
SILVER								1	2	2	2.00	1	1	0.59
THALLIUM	1	1	1	1.00	1	0	15	4	1	1	1.00	4	0	15
	GS09							GS10						
Total Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard
ARSENIC	6	405	21	155.50	6	2	50	15	895	15	285.33	15	13	50
LEAD	2	45	36	40.50	2	2	28	5	185	13	82.00	5	2	28
MERCURY	6	0.2	0.2	0.20	6	0	2	15	0.2	0.2	0.20	15	0	2
SELENIUM	6	1	1	1.00	6	0	10	15	26	1	7.00	15	6	10
SILVER								1	12	12	12.00	1	0	50
THALLIUM	1	1	1	1.00	1	1	0.012	4	1	1	1.00	4	4	0.012
	GS11							GS13						
Dissolved Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard
ARSENIC	1	18	18	18.00	1	0	150	10	14	1	2.30	10	0	150
LEAD	1	1	1	1.00	1	0	6.46	1	1	1	1.00	1	0	6.46
MERCURY	1	0.2	0.2	0.20	1	1	0.01	10	0.2	0.2	0.20	10	10	0.01
SELENIUM	1	1	1	1.00	1	0	17	10	17	1	6.80	10	0	17
THALLIUM								1	1	1	1.00	1	0	15
	GS11							GS13						
Total Metals [µg/L]	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard	Sample #	Max Value	Min Value	Avg Value	# < MDL	Exceeds	Standard
ARSENIC	1	19	19	19.00	1	0	50	9	154	1	46.44	9	2	50
LEAD	1	1	1	1.00	1	0	50	1	156	156	156.00	1	1	28
MERCURY	1	0.2	0.2	0.20	1	0	2	9	0.2	0.2	0.20	9	0	2
SELENIUM	1	1	1	1.00	1	0	10	9	54	1	11.00	9	4	10
THALLIUM								1	1	1	1.00	1	1	0.012

Source: EG&G, 1994. Event-Related Surface Water and Sediment Sampling Data for Water Year 1993. Provided by Greg Wetherbee, EG&G, Surface Water Division.

* GFAA is graphite furnace atomic adsorption. All metals were at values below the method detection limits (MDLs).

TABLE 4-8
NPDES STORMWATER MONITORING LOCATIONS

Location	Description	Total Drainage Area (ac)	IA Drainage Area (ac)	IA % of Total Area
SW022	Central Avenue Ditch	93	93	100
SW023 (GS10)	South Walnut Creek above the B-1 Bypass	95	95	100
SW027	South Interceptor Ditch above Pond C-2	186	34	18
SW093	North Walnut Creek below Portal 3	192	97	51
SW118	North Walnut Creek above Portal 3	21	4	19
SW998 "back-ground"	McKay Bypass below 130 Area	205	20	8

Source: Drainage area data were taken from the Rocky Flats Drainage and Flood Control Master Plan (WWE 1992). Description of sample locations was provided by Greg Wetherbee, EG&G Surface Water Division, September 1994.

Table 4-9

First Flush Stormwater Quality Data from November 1991 to August 1992 (1)

Sample Location:	WQCC Stream Standard (5)	Standard Value	SW022		SW023		SW093		SW118		SW027		SW998	
			Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
METALS (ug/L) (2) (6)														
Aluminum	NA	NA	59900	22245	26400	10770	39400	16264	113000	24793	7370	2241	N/A	N/A
Antimony	WQCC (SW)	14	56.8	24.6	44.8	16	19.9	12.2	76.6	24.8	24.9	16.7	N/A	N/A
Arsenic	WQCC (5)	50	37.5	18.6	70.5	30	37.5	28.1	79.2	40.1	37.5	28.3	N/A	N/A
Arsenic (3)	WQCC (5)	50	3.6	2.63	17.8	6.4	26.1	9.62	11.6	4.28	2.6	1.15	N/A	N/A
Barium	WQCC (SW)	1000	317	160	318	163	298	174	663	223	116	103	N/A	N/A
Beryllium (7)	WQCC (5)	4	2.4	1.28	1.7	0.58	1.5	0.82	3.3	1.09	0.5	0.45	N/A	N/A
Cadmium	WQCC (SW)	10	6.6	2.8	5.9	2.29	4.6	2.31	2	1.46	8.7	3.56	N/A	N/A
Chromium	WQCC (5) Cr-III/ WQCC (SW) Cr-VI	50/50	86.3	32.5	37.3	19.3	49.9	21.5	105	27.3	10.7	4.81	N/A	N/A
Cobalt	NA	NA	21.3	8.98	12.4	5.67	14.7	8.98	31.3	8.61	3.5	2.9	N/A	N/A
Copper	WQCC (5)	23	78	36.6	64.9	33.3	44.8	28.6	94.3	25.8	9.4	4.48	N/A	N/A
Iron	WQCC (5)	13200	60800	23433	27300	12541	34500	16248	90500	22191	6160	1915	N/A	N/A
Lead	WQCC (5)	28	141	66.9	76.4	37.9	63.8	30.4	45	29.7	27	20.5	N/A	N/A
Lead (3)	WQCC (5)	28	560	44.2	149	39	97	52.8	74.9	17.4	2.9	1.55	N/A	N/A
Manganese	WQCC (5)	1000	0.1	292	3370	648	1420	576	1820	554	78.2	33.1	N/A	N/A
Mercury (4)	WQCC (SW)	2	6	0.1	0.1	0.1	0.21	0.12	0.23	0.12	0.1	0.1	N/A	N/A
Molybdenum	NA	NA	51.9	4.18	6	4.78	6	5.32	7	5.52	6	5.4	N/A	N/A
Nickel	WQCC (SW ag)	200	31	25.3	34.5	12.3	32.2	16.1	6.95	24.6	9.5	8.36	N/A	N/A
Selenium	WQCC (5)	10	31	22.7	40	19.5	31	22.4	40	24.7	31	23.5	N/A	N/A
Selenium (3)	WQCC (5)	10	1	0.77	3.1	1.16	1.7	1.04	2	1.15	1.9	0.85	N/A	N/A
Silver	WQCC (SW)	50	3.5	2.43	35	3.96	2.5	2	7	3.4	2.5	2.13	N/A	N/A
Strontium	NA	NA	201	133	403	221	158	121	461	261	395	298	N/A	N/A
Thallium	WQCC (SW)	0.012	144	53	288	64.5	66.5	49.3	288	97.9	148	70.4	N/A	N/A
Thallium (3)	WQCC (SW)	0.012	0.5	0.5	2.3	0.7	3	1.16	5.5	1.43	0.5	0.5	N/A	N/A
Vanadium	NA	NA	142	55.3	63.6	29.3	88.8	40.8	235	56.1	19.5	8.38	N/A	N/A
Zinc	WQCC (5)	350	444	234	1020	490	594	304	566	187	66.7	34.9	N/A	N/A
INORGANICS (mg/L) (6)														
Calcium	NA	NA	44.3	30.8	70.5	41.1	32.8	22.3	65.9	36.6	64.8	49.6	N/A	N/A
Magnesium	NA	NA	13.2	7.27	18.1	9.06	8.85	6.36	30.2	12.9	13.5	10.3	N/A	N/A
Potassium	NA	NA	11.8	6.29	38.1	7.64	7.04	4.84	16.3	5.97	6.53	4.58	N/A	N/A
Sodium	NA	NA	47	17.2	136	27.3	18.2	11.9	153	60.8	31.9	24.8	N/A	N/A
Sulfate	WQCC (5)	250	8	5.2	41.7	17.1	11.7	6.18	25	11.8	58	34.4	N/A	N/A
Chloride	WQCC (5)	250	133	29.6	303	54.1	66	23.8	292	118	69	58	N/A	N/A
Fluoride	WQCC (SW)	2	1	0.48	10.2	0.94	0.8	0.53	1	0.43	0.38	0.27	N/A	N/A
Alkalinity	NA	NA	73.7	45.2	157	100	61.3	39.8	242	85	162	126	N/A	N/A
pH	WQCC (5)	6.5-9.0	8	7.7	7.9	7.4	8	7.4	8	7.5	7.7	7.4	N/A	N/A
Specific Conductance	NA	NA	420	216	640	375	300	213	1300	694	700	495	N/A	N/A
Dissolved Solids	NA	NA	264	139	722	239	647	199	621	301	404	288	N/A	N/A
Total Suspended Solids	NA	NA	926	520	1258	441	998	467	3031	672	95	34	N/A	N/A
Ammonia as N	WQCC (SW)	0.1	0.39	0.14	1.3	0.34	0.44	0.18	1.5	0.22	0.1	0.04	N/A	N/A
NO3/NO2 as N	WQCC (SW)	10	2.75	1.14	2.01	1.35	1.29	0.96	3.14	0.74	1.3	0.74	N/A	N/A
Total Phosphorus as P	NA	NA	1.5	0.62	2.31	0.68	2.4	0.58	1.05	0.39	0.12	0.07	N/A	N/A

(1) First flush samples were taken from beginning of the storm runoff at 1.5-minute intervals until the stream-channel stage declined below a pre-set level or until all 24 sample bottles were filled. Sampling data collected from October 1991 to December 1992. Data were reported in the NPDES Permit Application Monitoring Report for RFP (ASI 1993).

(2) All stormwater quality metals data are total recoverable concentrations.

(3) Analytical method used was graphite furnace atomic absorption (AA) spectroscopy.

(4) Analytical method used was cold vapor atomic absorption (AA) spectroscopy.

(5) When available, site specific stream standards established by the Colorado Water Quality Control Commission (WQCC) for Segment 5 of Big Dry Creek (WQCC 5) were used for purposes of water quality comparison. When these site-specific standards were not available, the state-wide WQCC (WQCC SW) standards were used.

(6) Values were determined using one-half the detection limit when the reported values were less than the detection limit.

(7) The WQCC site-specific standard for dissolved beryllium was used for purposes of comparison because no site-specific standard for total beryllium exists.

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TABLE 4-10

Hydrograph Integrated Stormwater Quality Data from November 1991 to August 1992 (1)

Sample Location:	WQCC Stream Standard (5)	Standard Value	SW022		SW023		SW093		SW118		SW027		SW998	
			Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
TOTAL METALS (µg/L) (2) (6)														
Aluminum	NA	NA	24100	5840	38900	11828	34800	13018	78200	22234	20200	4604	11600	5423
Antimony	WQCC (SW)	14	402	68.5	55.6	20.2	34.9	19	53.6	15.6	12.5	12	12.5	10
Arsenic	WQCC (5)	50	69	31	72	27.8	37.5	27.3	37.5	26.6	37.5	31.3	37.5	23.5
Arsenic (3)	WQCC (5)	50	6.5	2.71	14.9	5.6	7.2	2.9	16.9	4.28	1.9	0.82	3.9	2.2
Barium	WQCC (SW)	1000	200	79.6	282	139	225	132	509	229	179	112	62.5	38.9
Beryllium (7)	WQCC (5)	4	2.2	0.79	1.5	0.58	1.5	0.7	1.8	0.78	0.5	0.47	0.5	0.43
Cadmium	WQCC (SW)	10	7	2.65	3.7	1.83	5.6	2.54	2	1.51	2	1.93	2	1.52
Chromium	WQCC (5) Cr-III/ WQCC (SW) Cr-VI	50/50	34.9	10.9	53.4	19.6	39.1	16	72.8	22.6	25.5	6.68	21.7	10.1
Cobalt	NA	NA	11.6	4.64	13.7	5.15	8.5	6.2	24.1	8.01	3.5	3.1	3.5	2.9
Copper	WQCC (5)	23	45.4	15.5	60.6	27.7	39.5	19	73	27.3	22.7	7.15	21.2	11
Iron	WQCC (5)	13200	26300	6140	32800	11996	34300	12960	66200	21896	17100	3837	9990	4733
Lead	WQCC (5)	28	59.5	32.5	60.5	33.7	29	23.7	29.1	25.9	27	23.1	29	24.6
Lead (3)	WQCC (5)	28	32.9	12.9	82.2	33.8	36	24.6	56.2	18.1	8.2	3.52	37.3	20.6
Manganese	WQCC (5)	1000	482	116	912	341	536	380	1870	679	155	47.2	151	66.6
Mercury (4)	WQCC (SW)	2	0.2	0.11	0.2	0.11	0.1	0.1	0.23	0.11	0.1	0.1	0.1	0.1
Molybdenum	NA	NA	60.4	13	6	5.07	6	5.28	6	5.21	18.7	7.98	6	5.03
Nickel	WQCC (SW ag)	200	21.3	10.8	45.5	13.4	14.1	9.51	50.9	20.6	9.5	8.74	17.5	10.7
Selenium	WQCC (5)	10	40	22.7	31	19.2	31	21.8	31	21	31	26	31	18.8
Selenium (3)	WQCC (5)	10	1.3	0.77	1.9	1.13	0.5	0.5	21	0.97	0.5	0.5	0.5	0.5
Silver	WQCC (SW)	50	7	2.91	2.5	1.85	2.5	2	2.5	1.94	2.5	2.25	2.5	1.83
Strontium	NA	NA	262	136	411	190	136	104	348	253	457	268	40.6	26.2
Thallium	WQCC (SW)	0.012	288	78	66.5	45.4	66.5	47.5	66.5	47.6	66.5	55.5	66.5	41.4
Thallium (3)	WQCC (SW)	0.012	1	0.57	3	0.68	0.5	0.5	4.2	1.26	0.5	0.5	1.5	1
Vanadium	NA	NA	59.9	15.3	91.3	32.2	84.4	31.2	160	49.2	45.7	12.5	26.3	14.3
Zinc	WQCC (5)	350	346	103	658	342	280	203	473	188	107	41.7	221	146
INORGANICS (mg/L) (6)														
Calcium	NA	NA	39.2	26.4	60.6	34.6	19.8	18.1	47.1	34.5	73.4	44.3	6.61	5.31
Magnesium	NA	NA	8.15	5.1	13.7	7.62	8.09	5.15	22.1	11.9	14.7	9.26	2.98	1.75
Potassium	NA	NA	6.8	4.58	8.09	4.81	7.21	4.36	13.2	5.75	5.65	4.1	4.18	2.54
Sodium	NA	NA	39.6	18.6	44.6	17.3	24.9	17.8	141	85.5	37.2	22.3	6.55	3.63
Sulfate	WQCC (5)	250	25.9	6.66	38.4	14.3	11	6.72	23	12.2	63.1	24.8	4.85	3.9
Chloride	WQCC (5)	250	68	29.6	172	47.9	120	57.3	297	176	123	72	3.95	3.01
Fluoride	WQCC (SW)	2	0.71	0.26	0.57	0.24	0.35	0.23	1.3	0.33	0.48	0.32	0.27	0.26
Alkalinity	NA	NA	142	53.5	112	78.9	54.4	43.8	86.1	61.1	156	113.3	12.2	8.6
pH	WQCC (5)	6.5-9.0	8.1	7.6	8	7.5	7.9	7.3	7.9	7.4	8.1	7.8	7.6	6.9
Specific Conductance	NA	NA	540	216	560	311	260	203	1040	709	770	402	100	70
Dissolved Solids	NA	NA	271	153	470	224	184	131	582	394	474	273	102	58
Total Suspended Solids	NA	NA	570	200	1232	402	568	380	1659	505	384	94	219	90
Ammonia as N	WQCC (SW)	0.1	0.32	0.1	1.7	0.35	0.26	0.11	0.5	0.09	0.1	0.04	0.1	0.06
NO3/NO2 as N	WQCC (SW)	10	1.76	0.97	1.82	1.28	1.22	0.99	0.84	0.63	1.2	0.74	0.61	0.39
Total Phosphorus as P	NA	NA	0.54	0.28	1.44	0.54	1.1	0.68	0.86	0.35	0.84	0.07	0.06	0.03

(1) Hydrograph events were sampled with automatic samplers at the beginning of the storm runoff at pre-set time intervals until the stream-channel stage declined to a pre-set level.
Data were reported in the NPDES Permit Application Monitoring Report for RFP (ASI 1993)
(2) All stormwater quality metals data are total recoverable concentrations.
(3) Analytical method used was graphite furnace atomic absorption (AA) spectroscopy.
(4) Analytical method used was cold vapor atomic absorption (AA) spectroscopy.
(5) When available, site specific stream standards established by the Colorado Water Quality Control Commission (WQCC) for Segment 5 of Big Dry Creek (WQCC 5) were used for purposes of water quality comparison. When these site-specific standards were not available, the state-wide WQCC (WQCC SW) standards were used.
(6) Values were determined using one-half the detection limit when the reported values were less than the detection limit.
(7) The WQCC site-specific standard for dissolved beryllium was used for purposes of comparison because no site-specific standard for total beryllium exists.

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TABLE 4-11
NPDES MONITORING RESULTS
(1990-1993)

1990-1993 NPDES MONITORING RESULTS																				
	1990				January - April 1991				June - December 1991				1992				1993			
POND/PARAMETER	Number of Analyses	Minimum	Maximum	Mean	Number of Analyses	Minimum	Maximum	Mean	Number of Analyses	Minimum	Maximu	Mean	Number of Analyses	Minimum	Maximu	Mean	Number of Analyses	Minimum	Maximum	Mean
Discharge 001 (Pond B-3)																				
pH (standard units)	125	6.5	8.6	N/A	89	6.17	8.14	N/A												
Nitrate as N (mg/L)	127	0.75	12.8	3.39	35	0.65	4.24	1.83	88	0.15	13.3	4.48	106	0.28	13.7	3.36	105	0.28	6.27	2.1
Total Suspended Solids (mg/L)	127	0	78	11	35	0	26	7												
Total Residual Chlorine (mg/L)	238	0	0.35	0.06	89	0	0.3	0.02	244	0	0.41		366	0	1.9	0.03	365	0	0.2	0.04
Total Chromium (mg/L)	127	< 0.006	0.017	< 0.008	35	< 0.006	0.0107	0.0067												
Total Phosphorus (mg/L)	127	< 0.01	1.91	< 0.31	34	0.13	1.09	0.43												
BOD5 (mg/L)	125	< 2.5	37.8	< 7.8	33	< 2.5	11.8	6.4												
Fecal Coliform (#/100ml)	120	< 10	222,000	< 41	36	< 10	30	10												
Discharge 002 (Pond A-3)																				
pH (standard units)	57	7.2	8.6	N/A	3	8.2	8.65	N/A	39	7.17	8.95	N/A	55	7.16	8.48	N/A	35	7	8.3	N/A
Nitrate as N (mg/L)	58	1.12	6.61	4.6	3	0.66	4.12	2.94	39	0.71	3.33	1.62	56	0	3.8	1.7	36	0.66	4.4	1.6
Discharge 005 (Pond A-4)																				
pH (standard units)	162	6.6	8.6	N/A	64	6.3	8.15	N/A												
Nitrate as N (mg/L)	163	0.22	6.96	2.89	64	2.28	5.89	4.8												
NVSS (mg/L)	163	0	73	3	64	0	15	2												
Total Chromium (µg/L)									8	<5	6	6	10	<2.4	<7	<6.2	7	< 4.0	< 8	< 5.1
Discharge 006 (Pond B-5)					No Discharge				No Discharge				No Discharge				No Discharges			
pH (standard units)	93	7.1	8.5	N/A																
Nitrate as N (mg/L)	93	0.19	7.26	3.48																
NVSS (mg/L)	94	0	22	3																
Total Chromium (µg/L)																				
Discharge 007 (Pond C-2)					No Discharge															
pH (standard units)	45	7.2	8.4	N/A																
Nitrate as N (mg/L)	45	< 0.02	2.13	< 0.85																
NVSS (mg/L)	48	0	16	3																
Total Chromium (µg/L)									3	<7	<7	<7	2	<7	<7	<7	1	< 5	< 5	< 5
Discharge 995 (Wastewater Treatment Plant)																				
pH (standard units)									274	6.2	7.8	N/A	366	4.11	7.88	N/A	365	5.8	7.5	N/A
Total Suspended Solids (mg/L)									102	0	38	6	151	0	18	5.7	152	3	13	5.2
Oil and Grease (mg/l)									0	0	0	0	0	0	0	0	0	0	0	0
Total Phosphorus (mg/L)									111	< .1	2.52	0.39	149	< 0.01	6.1	0.23	151	0.068	4.58	1.39
Total Chromium (mg/L)									33	< 5	8.3	5.9	51	< 2.4	11.9	5.5	52	< 2.6	19.8	5.7
Fecal Coliform (#/100ml)									116	< 1	220	10	146	< 1	36	1.4	153	< 1	1100	1.3
CBOD (mg/L)									107	0.1	13.7	3.1	146	0.1	15	2	147	0	9.6	2.2

TABLE 4-12
(page 1 of 6)

RADIONUCLIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (pCi/L)	Sample Size	Samples Exceeding Standard Number (Pct)	Mean Concentration (pCi/L)	Standard Deviation (pCi/L)	85th Percentile (pCi/L)	Minimum (pCi/L)	Maximum (pCi/L)
A1	GROSS ALPHA	11	16	1 (6.2%)	7.983	4.259	9.000	3.7230	22.000
A1	GROSS BETA	19	17	0 (0.0%)	12.243	2.580	14.000	6.7000	17.690
A1	AMERICIUM-241	0.05	9	1 (11.1%)	0.019	0.021	0.037	0.0010	0.064
A1	PLUTONIUM-239/240	0.05	9	0 (0.0%)	0.025	0.012	0.035	0.0090	0.042
A1	URANIUM-233/234	10	9	0 (0.0%)	2.823	0.643	3.500	2.0000	4.000
A1	URANIUM-238	10	9	0 (0.0%)	4.310	1.056	5.200	2.3000	5.700
A2	GROSS ALPHA	11	18	2 (11.1%)	6.763	2.778	9.000	3.1000	13.040
A2	GROSS BETA	19	19	1 (5.3%)	12.056	4.246	14.000	4.0000	26.230
A2	AMERICIUM-241	0.05	11	1 (9.1%)	0.013	0.018	0.019	-0.0090	0.063
A2	PLUTONIUM-239/240	0.05	11	0 (0.0%)	0.019	0.010	0.032	0.0000	0.035
A2	URANIUM-233/234	10	11	0 (0.0%)	3.558	0.892	4.678	1.8170	4.952
A2	URANIUM-238	10	11	0 (0.0%)	4.778	1.474	6.516	2.2540	6.929
B1	GROSS ALPHA	11	16	1 (6.2%)	3.603	3.323	5.000	0.6400	15.000
B1	GROSS BETA	19	17	0 (0.0%)	7.386	2.087	9.600	4.8480	13.000
B1	AMERICIUM-241	0.05	8	3 (37.5%)	0.085	0.145	0.075	0.0060	0.440
B1	PLUTONIUM-239/240	0.05	9	3 (33.3%)	0.056	0.047	0.100	0.0180	0.160
B1	URANIUM-233/234	10	9	0 (0.0%)	1.407	0.648	2.300	0.4200	2.400
B1	URANIUM-238	10	9	0 (0.0%)	1.431	0.503	1.853	0.7400	2.200
B2	GROSS ALPHA	11	16	0 (0.0%)	4.045	2.933	7.000	0.0840	10.000
B2	GROSS BETA	19	17	1 (5.9%)	8.136	3.588	9.100	5.1000	21.110
B2	AMERICIUM-241	0.05	8	0 (0.0%)	0.025	0.018	0.045	0.0050	0.046
B2	PLUTONIUM-239/240	0.05	9	5 (55.6%)	0.071	0.053	0.130	0.0120	0.140
B2	URANIUM-233/234	10	9	0 (0.0%)	1.825	0.836	2.700	0.7900	3.100
B2	URANIUM-238	10	9	0 (0.0%)	1.531	0.690	2.300	0.7500	2.800

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POND A3 TOTAL RADIONUCLIDES SUMMARY STATISTICS

Analyte	Segment 4 Standard (pCi/L)	Sample Size	Samples Not Exceeding Standard Number (Pct)	Samples Exceeding Standard Number (Pct)	Mean (pCi/L)	85th Percentile (pCi/L)	Concentration Min. (pCi/L)	Concentration Max. (pCi/L)
AMERICIUM-241	0.05	9	9 (100.0%)	0 (0.0%)	0.0147	0.03	0.0045	0.034
CESIUM-137	None	9	9 (100.0%)	N/A	0.049	0.17	-0.092	0.37
CURIUM-244	None	8	8 (100.0%)	N/A	0.0009	0.003	-0.003	0.005
GROSS ALPHA	11	26	26 (100.0%)	0 (0.0%)	3.6521	4	2	5.63
GROSS BETA	19	26	26 (100.0%)	0 (0.0%)	5.8648	7	3	8.709
NEPTUNIUM-237	None	1	1 (100.0%)	N/A	0.054	0.054	0.054	0.054
PLUTONIUM-239/240	0.05	8	8 (100.0%)	0 (0.0%)	0.0088	0.017	-0.004	0.0247
STRONTIUM-89/90	8	9	9 (100.0%)	0 (0.0%)	0.6406	0.99	0.14	2.05
THORIUM-230/232	60	1	1 (100.0%)	0 (0.0%)	0.029	0.029	0.029	0.029
TRITIUM	500	17	17 (100.0%)	0 (0.0%)	46.529	168.6	-116	203.1
URANIUM-233/234	10	9	9 (100.0%)	0 (0.0%)	1.7689	2.272	1.3	2.748
URANIUM-235	10	9	9 (100.0%)	0 (0.0%)	0.0892	0.15	0	0.2255
URANIUM-238	10	9	9 (100.0%)	0 (0.0%)	2.6268	3.427	1.7	3.714

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POND A4 TOTAL RADIONUCLIDES SUMMARY STATISTICS

Analyte	Segment 4 Standard (pCi/L)	Sample Size	Samples Not Exceeding Standard Number (Pct)	Samples Exceeding Standard Number (Pct)	Mean (pCi/L)	85th Percentile (pCi/L)	Concentration Min. (pCi/L)	Concentration Max. (pCi/L)
AMERICIUM-241	0.05	38	37 (97.4%)	1 (2.6%)	0.0056	0.01	-0.002	0.067
CESIUM-137	None	26	26 (100.0%)	N/A	0.053	0.23	-0.42	0.6864
CURIUM-244	None	13	13 (100.0%)	N/A	0.0003	0.0058	-0.007	0.0076
GROSS ALPHA	11	102	102 (100.0%)	0 (0.0%)	1.8971	3	-0.6	6.16
GROSS BETA	19	102	102 (100.0%)	0 (0.0%)	9.0649	11	0	18
NEPTUNIUM-237	None	3	3 (100.0%)	N/A	0.0247	0.033	0.01	0.033
PLUTONIUM-239/240	0.05	39	38 (97.4%)	1 (2.6%)	0.0054	0.013	-0.004	0.067
STRONTIUM-89/90	8	28	28 (100.0%)	0 (0.0%)	0.396	0.63	0.13	1.625
THORIUM-230/232	60	4	4 (100.0%)	0 (0.0%)	0.0701	0.2905	-0.047	0.2905
TRITIUM	500	123	123 (100.0%)	0 (0.0%)	45.256	180	-794.6	294
URANIUM-233/234	10	39	39 (100.0%)	0 (0.0%)	1.039	1.5	0.4061	2.889
URANIUM-235	10	39	39 (100.0%)	0 (0.0%)	0.0682	0.11	-0.01	0.3254
URANIUM-238	10	39	39 (100.0%)	0 (0.0%)	1.1662	1.6	0.37	2.889

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POND B5 TOTAL RADIONUCLIDES SUMMARY STATISTICS

Analyte	Segment 4 Standard (pCi/L)	Sample Size	Samples Not Exceeding Standard Number (Pct)	Samples Exceeding Standard Number (Pct)	Mean (pCi/L)	85th Percentile (pCi/L)	Concentration Min. (pCi/L)	Concentration Max. (pCi/L)
AMERICIUM-241	0.05	24	24 (100.0%)	0 (0.0%)	0.0089	0.022	-0.004	0.0274
CESIUM-137	None	19	19 (100.0%)	N/A	0.1012	0.3101	-0.21	0.79
CURIUM-244	None	14	14 (100.0%)	N/A	0.0035	0.0027	-0.012	0.063
GROSS ALPHA	11	81	81 (100.0%)	0 (0.0%)	1.871	3	-0.1	9
GROSS BETA	19	81	81 (100.0%)	0 (0.0%)	9.4978	12	-14	15
NEPTUNIUM-237	None	3	3 (100.0%)	N/A	0.0457	0.084	0.022	0.084
PLUTONIUM-239/240	0.05	24	24 (100.0%)	0 (0.0%)	0.0096	0.022	-0.002	0.035
STRONTIUM-89/90	8	20	20 (100.0%)	0 (0.0%)	0.193	0.415	-0.184	0.75
THORIUM-230/232	60	4	4 (100.0%)	0 (0.0%)	-0.02	0.056	-0.149	0.056
TRITIUM	500	108	106 (98.1%)	2 (1.9%)	89.566	194.87	-205	1200
URANIUM-233/234	10	24	24 (100.0%)	0 (0.0%)	0.8044	1.1	0.24	1.6
URANIUM-235	10	24	24 (100.0%)	0 (0.0%)	0.0332	0.082	-0.021	0.14
URANIUM-238	10	24	24 (100.0%)	0 (0.0%)	0.6942	0.88	0.26	1.3

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POND C2 TOTAL RADIONUCLIDES SUMMARY STATISTICS

Analyte	Segment 4 Standard (pCi/L)	Sample Size	Samples Not Exceeding Standard Number (Pct)	Samples Exceeding Standard Number (Pct)	Mean (pCi/L)	85th Percentile (pCi/L)	Concentration Min. (pCi/L)	Concentration Max. (pCi/L)
AMERICIUM-241	0.05	28	28 (100.0%)	0 (0.0%)	0.0104	0.017	-0.002	0.0489
CESIUM-137	None	22	22 (100.0%)	N/A	0.0617	0.1931	-0.22	0.51
CURIUM-244	None	11	11 (100.0%)	N/A	-0.005	0.004	-0.054	0.0109
GROSS ALPHA	7	88	88 (100.0%)	0 (0.0%)	2.7731	4	-0.39	6
GROSS BETA	5	88	5 (5.7%)	83 (94.3%)	7.2239	8	-8.1	35.3
NEPTUNIUM-237	None	2	2 (100.0%)	N/A	0.0475	0.095	0	0.095
PLUTONIUM-239/240	0.05	27	21 (77.8%)	6 (22.2%)	0.0303	0.0541	0.002	0.13
STRONTIUM-89/90	8	23	23 (100.0%)	0 (0.0%)	0.4136	0.67	0	0.84
THORIUM-230/232	60	3	3 (100.0%)	0 (0.0%)	0.1047	0.233	-0.005	0.233
TRITIUM	500	106	105 (99.1%)	1 (0.9%)	42.162	150	-221	585.13
URANIUM-233/234	5	27	27 (100.0%)	0 (0.0%)	1.1296	1.6	0.066	2
URANIUM-235	5	27	27 (100.0%)	0 (0.0%)	0.1054	0.15	0	0.62
URANIUM-238	5	27	27 (100.0%)	0 (0.0%)	1.2764	1.954	0.003	2.6

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RADIONUCLIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (pCi/L)	Sample Size	Samples Exceeding Standard Number (Pct)	Mean Concentration (pCi/L)	Standard Deviation (pCi/L)	85th Percentile (pCi/L)	Minimum (pCi/L)	Maximum (pCi/L)
SW098	GROSS ALPHA	11	22	0 (0.0%)	1.858	1.586	3.100	-0.6700	6.700
SW098	GROSS BETA	19	22	2 (9.1%)	13.414	10.528	12.690	7.9000	59.260
SW098	AMERICIUM-241	0.05	20	1 (5.0%)	0.009	0.017	0.015	-0.0030	0.075
SW098	PLUTONIUM-239/240	0.05	20	0 (0.0%)	0.005	0.007	0.009	-0.0004	0.023
SW098	URANIUM-233/234	10	14	0 (0.0%)	1.077	0.292	1.316	0.7030	1.594
SW098	URANIUM-238	10	14	0 (0.0%)	1.015	0.342	1.246	0.6140	1.964

TABLE 4-13

POND A1 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	12	2 (16.7%)	10 (83.3%)	N/A	1380	41	1500	108	108
ANTIMONY	14	12	12 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	11	42.2
ARSENIC	50	12	0 (0.0%)	12 (100.0%)	0 (0.0%)	9.14	1.7	12.9	N/A	N/A
BARIUM	1000	12	0 (0.0%)	12 (100.0%)	0 (0.0%)	107	16.8	141	N/A	N/A
BERYLLIUM	4	12	12 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.3	1
CADMIUM	10	11	10 (90.9%)	1 (9.1%)	0 (0.0%)	Nondetect	1.4	1.4	1	5
CALCIUM	None	12	0 (0.0%)	12 (100.0%)	N/A	36000	11700	37600	N/A	N/A
CESIUM	None	9	8 (88.9%)	1 (11.1%)	N/A	Nondetect	120	120	50	500
CHROMIUM	50	12	11 (91.7%)	1 (8.3%)	0 (0.0%)	Nondetect	2.9	2.9	2	8
COBALT	None	12	12 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	2	8
COPPER	23	12	8 (66.7%)	4 (33.3%)	0 (0.0%)	5.8	2.8	7.7	2	5.4
IRON	13200	12	0 (0.0%)	12 (100.0%)	0 (0.0%)	1100	68.8	1200	N/A	N/A
LEAD	28	12	8 (66.7%)	4 (33.3%)	0 (0.0%)	2.9	1.8	4.1	0.9	2
LITHIUM	None	10	0 (0.0%)	10 (100.0%)	N/A	56.2	32	130	N/A	N/A
MAGNESIUM	None	12	0 (0.0%)	12 (100.0%)	N/A	38500	17000	68500	N/A	N/A
MANGANESE	1000	12	0 (0.0%)	12 (100.0%)	0 (0.0%)	256	11.1	532	N/A	N/A
MERCURY	2	12	10 (83.3%)	2 (16.7%)	0 (0.0%)	0.15	0.15	0.46	0.2	0.2
MOLYBDENUM	None	14	13 (92.9%)	1 (7.1%)	N/A	Nondetect	11.5	11.5	3	11
NICKEL	200	12	9 (75.0%)	3 (25.0%)	0 (0.0%)	20.8	6.2	23.7	3.9	15.1
POTASSIUM	None	12	0 (0.0%)	12 (100.0%)	N/A	10000	4300	17800	N/A	N/A
SELENIUM	10	12	9 (75.0%)	3 (25.0%)	0 (0.0%)	1.8	1	4	1	4
SILICON	None	11	0 (0.0%)	11 (100.0%)	N/A	1750	196	2640	N/A	N/A
SILVER	50	12	12 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	2	6.8
SODIUM	None	12	0 (0.0%)	12 (100.0%)	N/A	232000	140000	362000	N/A	N/A
STRONTIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	436	170	641	N/A	N/A
THALLIUM	0.012	12	10 (83.3%)	0 (0.0%)	2 (16.7%)	1.6	1.6	2.1	1	20
TIN	None	10	9 (90.0%)	1 (10.0%)	N/A	Nondetect	17	17	6.7	38.9
VANADIUM	None	12	6 (50.0%)	6 (50.0%)	N/A	6.6	2.3	7.1	2.1	11
ZINC	350	12	4 (33.3%)	8 (66.7%)	0 (0.0%)	26	3.1	27.5	1.8	7.2

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POND A2 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	14	1 (7.1%)	13 (92.9%)	N/A	160	43.5	320	108	108
ANTIMONY	14	14	13 (92.9%)	0 (0.0%)	1 (7.1%)	Nondetect	16.9	16.9	11	34
ARSENIC	50	13	3 (23.1%)	10 (76.9%)	0 (0.0%)	7.4	1.3	7.8	0.9	4
BARIUM	1000	14	0 (0.0%)	14 (100.0%)	0 (0.0%)	60.9	19.3	76	N/A	N/A
BERYLLIUM	4	14	14 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.3	1
CADMIUM	10	13	13 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	5
CALCIUM	None	14	0 (0.0%)	14 (100.0%)	N/A	42000	14000	46800	N/A	N/A
CESIUM	None	10	10 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	50	500
CHROMIUM	50	14	14 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	2	8
COBALT	None	14	13 (92.9%)	1 (7.1%)	N/A	Nondetect	4.5	4.5	2	8
COPPER	23	14	11 (78.6%)	3 (21.4%)	0 (0.0%)	3.7	3.7	6	2	4.7
IRON	13200	14	0 (0.0%)	14 (100.0%)	0 (0.0%)	240	38.3	354	N/A	N/A
LEAD	28	13	8 (61.5%)	5 (38.5%)	0 (0.0%)	11	1.6	17.3	0.9	2
LITHIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	54.4	35.7	61.1	N/A	N/A
MAGNESIUM	None	14	0 (0.0%)	14 (100.0%)	N/A	32900	26700	35100	N/A	N/A
MANGANESE	1000	14	0 (0.0%)	14 (100.0%)	0 (0.0%)	210	19.6	684	N/A	N/A
MERCURY	2	13	11 (84.6%)	2 (15.4%)	0 (0.0%)	0.27	0.27	0.36	0.1	0.2
MOLYBDENUM	None	18	14 (77.8%)	4 (22.2%)	N/A	4.2	4.2	6.9	3	11
NICKEL	200	14	10 (71.4%)	4 (28.6%)	0 (0.0%)	4.8	4.4	6.3	3.9	15.1
POTASSIUM	None	14	0 (0.0%)	14 (100.0%)	N/A	8030	5700	9010	N/A	N/A
SELENIUM	10	13	12 (92.3%)	1 (7.7%)	0 (0.0%)	Nondetect	1.2	1.2	1	4
SILICON	None	11	0 (0.0%)	11 (100.0%)	N/A	2580	332	2680	N/A	N/A
SILVER	50	14	13 (92.9%)	1 (7.1%)	0 (0.0%)	Nondetect	6.4	6.4	2	6
SODIUM	None	14	0 (0.0%)	14 (100.0%)	N/A	184000	130000	205000	N/A	N/A
STRONTIUM	None	13	0 (0.0%)	13 (100.0%)	N/A	432	221	486	N/A	N/A
THALLIUM	0.012	13	11 (84.6%)	0 (0.0%)	2 (15.4%)	1.3	1.3	1.6	1	20
TIN	None	11	11 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	6.7	21
VANADIUM	None	14	10 (71.4%)	4 (28.6%)	N/A	3.2	3.1	4.5	2	11
ZINC	350	14	6 (42.9%)	8 (57.1%)	0 (0.0%)	7.5	2.8	19	1.8	5

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POND A3 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	9	0 (0.0%)	9 (100.0%)	N/A	869	269	1100	N/A	N/A
ANTIMONY	14	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	11	38
ARSENIC	50	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.9	4
BARIUM	1000	10	0 (0.0%)	10 (100.0%)	0 (0.0%)	100	69.7	101	N/A	N/A
BERYLLIUM	4	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.5	1
CADMIUM	10	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	1.9	1.9	1	4
CALCIUM	None	10	0 (0.0%)	10 (100.0%)	N/A	44200	33000	45500	N/A	N/A
CESIUM	None	9	8 (88.9%)	1 (11.1%)	N/A	Nondetect	60	60	50	500
CHROMIUM	50	10	9 (90.0%)	1 (10.0%)	0 (0.0%)	Nondetect	2	2	2	5
COBALT	None	10	9 (90.0%)	1 (10.0%)	N/A	Nondetect	3.4	3.4	2	4
COPPER	200	10	6 (60.0%)	4 (40.0%)	0 (0.0%)	6.9	2.4	14	2	7
IRON	1000	10	0 (0.0%)	10 (100.0%)	0 (0.0%)	621	275	800	N/A	N/A
LEAD	50	10	5 (50.0%)	5 (50.0%)	0 (0.0%)	3.5	1.7	4	0.9	1
LITHIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	9.8	5.5	12.1	N/A	N/A
MAGNESIUM	None	10	0 (0.0%)	10 (100.0%)	N/A	12000	8300	15000	N/A	N/A
MANGANESE	1000	10	0 (0.0%)	10 (100.0%)	0 (0.0%)	84	22	116	N/A	N/A
MERCURY	2	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	0.2
MOLYBDENUM	None	10	9 (90.0%)	1 (10.0%)	N/A	Nondetect	8.2	8.2	3	26
NICKEL	200	10	7 (70.0%)	3 (30.0%)	0 (0.0%)	6.4	4.1	6.5	3.9	15
POTASSIUM	None	10	0 (0.0%)	10 (100.0%)	N/A	4840	2640	4880	N/A	N/A
SELENIUM	10	10	7 (70.0%)	3 (30.0%)	0 (0.0%)	1.5	1.5	3.4	1.1	4
SILICON	None	9	0 (0.0%)	9 (100.0%)	N/A	3450	1860	3550	N/A	N/A
SILVER	50	10	8 (80.0%)	2 (20.0%)	0 (0.0%)	4.6	4.6	5.1	2	5
SODIUM	None	10	0 (0.0%)	10 (100.0%)	N/A	41000	23000	52000	N/A	N/A
STRONTIUM	None	10	0 (0.0%)	10 (100.0%)	N/A	300	206	327	N/A	N/A
THALLIUM	0.012	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	10
TIN	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10.4	16
VANADIUM	None	10	6 (60.0%)	4 (40.0%)	N/A	4.2	2.6	4.5	2	5.7
ZINC	2000	10	1 (10.0%)	9 (90.0%)	0 (0.0%)	29.1	4.6	54	5	5

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POND A4 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	51	3 (5.9%)	48 (94.1%)	N/A	325	21.4	822	14	66
ANTIMONY	14	51	51 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	8	51.5
ARSENIC	50	51	32 (62.7%)	19 (37.3%)	0 (0.0%)	3.1	1.2	5.8	1	131
BARIUM	1000	51	1 (2.0%)	50 (98.0%)	0 (0.0%)	86.1	45	108.94	5	5
BERYLLIUM	4	51	49 (96.1%)	0 (0.0%)	0 (0.0%)	Nondetect	0.8	1.5162	0.3	1
CADMIUM	10	51	47 (92.2%)	4 (7.8%)	0 (0.0%)	Nondetect	0.13	2.3	0.1	4
CALCIUM	None	54	0 (0.0%)	54 (100.0%)	N/A	50500	706	55243	N/A	N/A
CESIUM	None	34	30 (88.2%)	4 (11.8%)	N/A	Nondetect	50	70	2	500
CHROMIUM	50	102	90 (88.2%)	12 (11.8%)	0 (0.0%)	Nondetect	0.0053	11.7	0.005	8.1
COBALT	None	51	46 (90.2%)	5 (9.8%)	N/A	Nondetect	2.6	4	1.3	8
COPPER	200	51	25 (49.0%)	26 (51.0%)	0 (0.0%)	4.3	2.2	7.5	1.4	11.9
IRON	1000	51	3 (5.9%)	48 (94.1%)	0 (0.0%)	226	10.8	716	11	100
LEAD	50	51	25 (49.0%)	24 (47.1%)	2 (3.9%)	3.7	1.1	70.9	0.7	73
LITHIUM	None	34	1 (2.9%)	33 (97.1%)	N/A	13.1	6.5	24.5	5.9	5.9
MAGNESIUM	None	54	1 (1.9%)	53 (98.1%)	N/A	10900	7200	13000	32	32
MANGANESE	1000	51	1 (2.0%)	50 (98.0%)	0 (0.0%)	143	1.7	710	1	1
MERCURY	2	42	39 (92.9%)	3 (7.1%)	0 (0.0%)	Nondetect	0.16	0.2	0.1	0.2
MOLYBDENUM	None	50	28 (56.0%)	22 (44.0%)	N/A	7.1	4.8	12.5	2.7	35
NICKEL	200	51	41 (80.4%)	10 (19.6%)	0 (0.0%)	3.4	3.1	12.31	2.6	21
POTASSIUM	None	51	1 (2.0%)	50 (98.0%)	N/A	9830	5850	11522	1190	1190
SELENIUM	10	51	44 (86.3%)	7 (13.7%)	0 (0.0%)	Nondetect	1	2.1	1	76
SILICON	None	17	0 (0.0%)	17 (100.0%)	N/A	3590	1540	4600	N/A	N/A
SILVER	50	51	51 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	6
SODIUM	None	51	1 (2.0%)	50 (98.0%)	N/A	45900	26500	50697	1610	1610
STRONTIUM	None	50	0 (0.0%)	50 (100.0%)	N/A	311	2.7	359.3	N/A	N/A
THALLIUM	0.012	51	51 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	182
TIN	None	34	32 (94.1%)	2 (5.9%)	N/A	Nondetect	15.8	31	6.2	136
VANADIUM	None	51	38 (74.5%)	13 (25.5%)	N/A	3.9	2.1	5.2	2	11
ZINC	2000	51	3 (5.9%)	48 (94.1%)	0 (0.0%)	32.1	4.6	71.895	10	41.7

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POND B1 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	11	2 (18.2%)	9 (81.8%)	N/A	520	98	5780	108	108
ANTIMONY	14	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	11	42.2
ARSENIC	50	11	7 (63.6%)	4 (36.4%)	0 (0.0%)	3.1	1.5	11.7	0.9	131
BARIUM	1000	11	1 (9.1%)	10 (90.9%)	0 (0.0%)	102	8.7	163	79.2	79.2
BERYLLIUM	4	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	1
CADMIUM	10	11	10 (90.9%)	1 (9.1%)	0 (0.0%)	Nondetect	1.6	1.6	2.4	5
CALCIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	45600	18700	47400	N/A	N/A
CESIUM	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	50	1000
CHROMIUM	50	11	10 (90.9%)	1 (9.1%)	0 (0.0%)	Nondetect	5	5	2	8
COBALT	None	11	10 (90.9%)	1 (9.1%)	N/A	Nondetect	2.9	2.9	2	8
COPPER	23	11	8 (72.7%)	3 (27.3%)	0 (0.0%)	4.2	3.7	8.4	2.1	9
IRON	13200	11	0 (0.0%)	11 (100.0%)	0 (0.0%)	470	156	3720	N/A	N/A
LEAD	28	11	6 (54.5%)	5 (45.5%)	0 (0.0%)	1.9	0.9	2.4	0.9	1.4
LITHIUM	None	9	1 (11.1%)	8 (88.9%)	N/A	15.2	11.9	30.8	100	100
MAGNESIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	23800	12600	29800	N/A	N/A
MANGANESE	1000	11	0 (0.0%)	11 (100.0%)	0 (0.0%)	165	15.7	311	N/A	N/A
MERCURY	2	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	0.2
MOLYBDENUM	None	12	10 (83.3%)	2 (16.7%)	N/A	6.8	6.8	11.2	3	100
NICKEL	200	11	9 (81.8%)	2 (18.2%)	0 (0.0%)	6.7	6.7	16.3	3.9	15
POTASSIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	8140	3410	8910	N/A	N/A
SELENIUM	10	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	76
SILICON	None	10	0 (0.0%)	10 (100.0%)	N/A	1450	192	1500	N/A	N/A
SILVER	50	11	10 (90.9%)	1 (9.1%)	0 (0.0%)	Nondetect	4	4	0.2	6.8
SODIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	81200	45000	211000	N/A	N/A
STRONTIUM	None	11	1 (9.1%)	10 (90.9%)	N/A	389	230	524	1000	1000
THALLIUM	0.012	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.9	164
TIN	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10.4	100
VANADIUM	None	11	9 (81.8%)	2 (18.2%)	N/A	2.9	2.9	3.3	2	11
ZINC	350	11	3 (27.3%)	8 (72.7%)	0 (0.0%)	24.8	4.4	34.9	1.8	7.2

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POND B2 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	11	2 (18.2%)	9 (81.8%)	N/A	621	66.7	1280	108	108
ANTIMONY	14	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	11	42.2
ARSENIC	50	11	6 (54.5%)	5 (45.5%)	0 (0.0%)	3.6	1.8	4.1	0.9	131
BARIUM	1000	11	0 (0.0%)	11 (100.0%)	0 (0.0%)	134	2.2	143	N/A	N/A
BERYLLIUM	4	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.5	1
CADMIUM	10	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	2.4	5
CALCIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	56000	14800	56500	N/A	N/A
CESIUM	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	50	500
CHROMIUM	50	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	2	8
COBALT	None	11	10 (90.9%)	1 (9.1%)	N/A	Nondetect	3.1	3.1	2	8
COPPER	23	11	8 (72.7%)	3 (27.3%)	0 (0.0%)	3.7	3.1	4.2	2	9
IRON	13200	11	0 (0.0%)	11 (100.0%)	0 (0.0%)	816	132	1200	N/A	N/A
LEAD	28	11	5 (45.5%)	6 (54.5%)	0 (0.0%)	4.8	1.2	11	0.9	1
LITHIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	23.6	19	35.6	N/A	N/A
MAGNESIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	25900	21000	33300	N/A	N/A
MANGANESE	1000	11	0 (0.0%)	11 (100.0%)	0 (0.0%)	108	21.9	148	N/A	N/A
MERCURY	2	10	10 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	0.2
MOLYBDENUM	None	12	12 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	3	10
NICKEL	200	11	9 (81.8%)	2 (18.2%)	0 (0.0%)	7.4	7.4	12.8	3.9	15
POTASSIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	6550	4480	7600	N/A	N/A
SELENIUM	10	11	11 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	76
SILICON	None	10	0 (0.0%)	10 (100.0%)	N/A	2590	224	3580	N/A	N/A
SILVER	50	11	9 (81.8%)	1 (9.1%)	1 (9.1%)	3.6	3.6	56.9	2	6.8
SODIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	69500	57300	86600	N/A	N/A
STRONTIUM	None	11	0 (0.0%)	11 (100.0%)	N/A	433	225	480	N/A	N/A
THALLIUM	0.012	11	10 (90.9%)	0 (0.0%)	1 (9.1%)	Nondetect	2.1	2.1	1	164
TIN	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10.4	38.9
VANADIUM	None	11	9 (81.8%)	2 (18.2%)	N/A	4	4	4.5	2	11
ZINC	350	11	4 (36.4%)	7 (63.6%)	0 (0.0%)	10.4	4.5	12.8	1.8	7.2

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POND B5 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	33	0 (0.0%)	33 (100.0%)	N/A	1050	14.8	3250	N/A	N/A
ANTIMONY	14	34	33 (97.1%)	0 (0.0%)	1 (2.9%)	Nondetect	22.6	22.6	8	39
ARSENIC	50	34	24 (70.6%)	10 (29.4%)	0 (0.0%)	2.4	0.7	4.4	1	131
BARIUM	1000	34	0 (0.0%)	34 (100.0%)	0 (0.0%)	73.1	37.6	83.6	N/A	N/A
BERYLLIUM	4	34	33 (97.1%)	0 (0.0%)	0 (0.0%)	Nondetect	1	1	0.3	1
CADMIUM	10	34	32 (94.1%)	2 (5.9%)	0 (0.0%)	Nondetect	1	2.3	1	4
CALCIUM	None	36	0 (0.0%)	36 (100.0%)	N/A	43700	31800	48000	N/A	N/A
CESIUM	None	19	18 (94.7%)	1 (5.3%)	N/A	Nondetect	50	50	36	500
CHROMIUM	50	86	74 (86.0%)	12 (14.0%)	0 (0.0%)	Nondetect	0.0052	9.5	0.005	8
COBALT	None	34	30 (88.2%)	4 (11.8%)	N/A	Nondetect	2.8	4.1	1.3	8
COPPER	200	34	17 (50.0%)	17 (50.0%)	0 (0.0%)	8.7	1.7	30.3	1.9	11
IRON	1000	34	0 (0.0%)	30 (88.2%)	4 (11.8%)	559	12.4	2420	N/A	N/A
LEAD	50	34	20 (58.8%)	14 (41.2%)	0 (0.0%)	3.5	1	4.8	0.8	73
LITHIUM	None	20	0 (0.0%)	20 (100.0%)	N/A	22.35	5	32.2	N/A	N/A
MAGNESIUM	None	36	0 (0.0%)	36 (100.0%)	N/A	8780	5790	16700	N/A	N/A
MANGANESE	1000	34	0 (0.0%)	34 (100.0%)	0 (0.0%)	167	2.6	346.11	N/A	N/A
MERCURY	2	23	22 (95.7%)	1 (4.3%)	0 (0.0%)	Nondetect	0.4	0.4	0.1	0.2
MOLYBDENUM	None	33	17 (51.5%)	16 (48.5%)	N/A	15.311	3.5	18.948	4	35
NICKEL	200	34	26 (76.5%)	8 (23.5%)	0 (0.0%)	4.6	2.8	13.108	3	19
POTASSIUM	None	34	0 (0.0%)	34 (100.0%)	N/A	11966	5480	13505	N/A	N/A
SELENIUM	10	34	29 (85.3%)	5 (14.7%)	0 (0.0%)	Nondetect	0.9	9.3	1	76
SILICON	None	6	0 (0.0%)	6 (100.0%)	N/A	7480	2820	7480	N/A	N/A
SILVER	50	34	33 (97.1%)	1 (2.9%)	0 (0.0%)	Nondetect	5.9	5.9	2	7
SODIUM	None	34	0 (0.0%)	34 (100.0%)	N/A	36194	3000	61200	N/A	N/A
STRONTIUM	None	33	0 (0.0%)	33 (100.0%)	N/A	249	164	396	N/A	N/A
THALLIUM	0.012	34	34 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	288
TIN	None	20	18 (90.0%)	2 (10.0%)	N/A	Nondetect	11.5	13	6.2	25
VANADIUM	None	34	19 (55.9%)	15 (44.1%)	N/A	5.1	2.8	17.1	2	11
ZINC	2000	34	1 (2.9%)	33 (97.1%)	0 (0.0%)	59.7	8.4	136.49	15.9	15.9

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POND C2 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	35	0 (0.0%)	35 (100.0%)	N/A	403.53	12	4180	N/A	N/A
ANTIMONY	14	35	35 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	8	34
ARSENIC	50	35	18 (51.4%)	17 (48.6%)	0 (0.0%)	4.3	1.5	5.3	1.8	131
BARIUM	1000	35	0 (0.0%)	35 (100.0%)	0 (0.0%)	102	49	120	N/A	N/A
BERYLLIUM	4	35	34 (97.1%)	0 (0.0%)	0 (0.0%)	Nondetect	1.154	1.154	0.3	3
CADMIUM	10	34	31 (91.2%)	3 (8.8%)	0 (0.0%)	Nondetect	1.2	2.7	0.2	4
CALCIUM	None	37	0 (0.0%)	37 (100.0%)	N/A	52000	27800	54581	N/A	N/A
CESIUM	None	24	22 (91.7%)	2 (8.3%)	N/A	Nondetect	50	50	23	500
CHROMIUM	50	83	74 (89.2%)	9 (10.8%)	0 (0.0%)	Nondetect	0.0051	7.5	0.005	7
COBALT	None	35	32 (91.4%)	3 (8.6%)	N/A	Nondetect	2.5	6.1	1.3	7
COPPER	200	35	21 (60.0%)	14 (40.0%)	0 (0.0%)	6.2	2.7	11.5	1.9	9
IRON	1000	35	0 (0.0%)	34 (97.1%)	1 (2.9%)	783	25.7	3430	N/A	N/A
LEAD	50	35	15 (42.9%)	20 (57.1%)	0 (0.0%)	3	1.3	14	1	73
LITHIUM	None	24	0 (0.0%)	24 (100.0%)	N/A	11.4	3.3	14.1	N/A	N/A
MAGNESIUM	None	37	0 (0.0%)	37 (100.0%)	N/A	17000	7690	18800	N/A	N/A
MANGANESE	1000	35	0 (0.0%)	35 (100.0%)	0 (0.0%)	629	3.3	903	N/A	N/A
MERCURY	2	27	25 (92.6%)	2 (7.4%)	0 (0.0%)	Nondetect	0.19	0.2	0.1	0.2
MOLYBDENUM	None	35	28 (80.0%)	7 (20.0%)	N/A	3.8	3	35	3	26
NICKEL	200	35	27 (77.1%)	8 (22.9%)	0 (0.0%)	5.6	4.2	16.6	2.6	19
POTASSIUM	None	35	0 (0.0%)	35 (100.0%)	N/A	6400	3280	11700	N/A	N/A
SELENIUM	10	35	33 (94.3%)	2 (5.7%)	0 (0.0%)	Nondetect	1.6	3.2	0.8	76
SILICON	None	7	0 (0.0%)	7 (100.0%)	N/A	3990	2540	5110	N/A	N/A
SILVER	50	34	33 (97.1%)	1 (2.9%)	0 (0.0%)	Nondetect	2.6	2.6	0.2	6
SODIUM	None	35	0 (0.0%)	35 (100.0%)	N/A	58883	34200	66300	N/A	N/A
STRONTIUM	None	35	0 (0.0%)	35 (100.0%)	N/A	405	220	424	N/A	N/A
THALLIUM	0.012	35	35 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	164
TIN	None	24	24 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	6.2	32
VANADIUM	None	35	27 (77.1%)	8 (22.9%)	N/A	2.6	2.4	11.9	2	11
ZINC	2000	35	6 (17.1%)	29 (82.9%)	0 (0.0%)	26	3.2	42.414	2.2	11.6

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POND SW098 TOTAL METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	None	28	7 (25.0%)	21 (75.0%)	N/A	144	30.4	271	17	200
ANTIMONY	14	28	26 (92.9%)	0 (0.0%)	2 (7.1%)	Nondetect	16.9	16.9	8	60
ARSENIC	50	27	14 (51.9%)	13 (48.1%)	0 (0.0%)	2	1.1	3.22	0.8	10
BARIUM	1000	28	0 (0.0%)	28 (100.0%)	0 (0.0%)	208	16	250	N/A	N/A
BERYLLIUM	4	28	27 (96.4%)	0 (0.0%)	0 (0.0%)	Nondetect	0.7	0.7	0.5	5
CADMIUM	10	28	27 (96.4%)	1 (3.6%)	0 (0.0%)	Nondetect	2.1	2.1	1	5
CALCIUM	None	28	0 (0.0%)	28 (100.0%)	N/A	51200	3180	55800	N/A	N/A
CESIUM	None	22	20 (90.9%)	2 (9.1%)	N/A	Nondetect	50	50	33	2500
CHROMIUM	50	28	26 (92.9%)	2 (7.1%)	0 (0.0%)	Nondetect	3.2	10.9	2	10
COBALT	None	28	28 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	2	50
COPPER	23	28	18 (64.3%)	9 (32.1%)	1 (3.6%)	8	3.2	27.5	2	25
IRON	13200	28	0 (0.0%)	28 (100.0%)	0 (0.0%)	823	16.3	1150	N/A	N/A
LEAD	28	27	19 (70.4%)	8 (29.6%)	0 (0.0%)	2.4	1.5	5.3	0.9	20
LITHIUM	None	23	1 (4.3%)	22 (95.7%)	N/A	94.9	7.7	109	100	100
MAGNESIUM	None	28	0 (0.0%)	28 (100.0%)	N/A	43500	4270	48300	N/A	N/A
MANGANESE	1000	28	1 (3.6%)	27 (96.4%)	0 (0.0%)	167	7.5	430	2.5	2.5
MERCURY	2	27	24 (88.9%)	3 (11.1%)	0 (0.0%)	Nondetect	0.22	0.54	0.1	0.2
MOLYBDENUM	None	28	25 (89.3%)	3 (10.7%)	N/A	Nondetect	9.5	13.1	3	100
NICKEL	200	28	14 (50.0%)	14 (50.0%)	0 (0.0%)	12.2	6.3	22	9.9	40
POTASSIUM	None	28	0 (0.0%)	28 (100.0%)	N/A	9740	1360	10900	N/A	N/A
SELENIUM	10	27	27 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	5
SILICON	None	17	0 (0.0%)	17 (100.0%)	N/A	3560	298	3710	N/A	N/A
SILVER	50	28	24 (85.7%)	4 (14.3%)	0 (0.0%)	Nondetect	2	4	0.2	10
SODIUM	None	28	0 (0.0%)	28 (100.0%)	N/A	183000	19900	196000	N/A	N/A
STRONTIUM	None	26	0 (0.0%)	26 (100.0%)	N/A	572	44.9	598	N/A	N/A
THALLIUM	0.012	27	25 (92.6%)	0 (0.0%)	2 (7.4%)	Nondetect	2	7.4	0.9	10
TIN	None	23	17 (73.9%)	6 (26.1%)	N/A	26.3	17.9	44.3	10	100
VANADIUM	None	28	23 (82.1%)	5 (17.9%)	N/A	3.9	3.9	9	2	50
ZINC	350	28	3 (10.7%)	25 (89.3%)	0 (0.0%)	22.9	4.4	107	4	7.2

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POND A3 FILTERED METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	87	9	6 (66.7%)	3 (33.3%)	0 (0.0%)	31	23	64	14	108
ANTIMONY	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	11	25.6
ARSENIC	150	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	3.1	3.1	0.9	2
BARIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	87	65.2	110	N/A	N/A
BERYLLIUM	4	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.5	1
CADMIUM	1.5	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	1.3	1.3	1	3
CALCIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	44800	34000	45000	N/A	N/A
CESIUM	None	9	7 (77.8%)	2 (22.2%)	N/A	50	50	105	50	500
CHROMIUM	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	2	4.1
COBALT	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	2	4
COPPER	16	9	5 (55.6%)	4 (44.4%)	0 (0.0%)	6.1	2.4	13	2.1	4.7
IRON	300	9	4 (44.4%)	5 (55.6%)	0 (0.0%)	49	7.7	230	7	16.7
LEAD	6.5	9	5 (55.6%)	4 (44.4%)	0 (0.0%)	1.8	1.4	2	0.9	1
LITHIUM	None	9	1 (11.1%)	8 (88.9%)	N/A	10.8	6.4	11	7.1	7.1
MAGNESIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	13000	7900	14800	N/A	N/A
MANGANESE	50	9	0 (0.0%)	7 (77.8%)	2 (22.2%)	90.8	3	124.5	N/A	N/A
MERCURY	0.01	9	8 (88.9%)	0 (0.0%)	1 (11.1%)	Nondetect	0.34	0.34	0.2	0.2
MOLYBDENUM	None	9	8 (88.9%)	1 (11.1%)	N/A	Nondetect	3.1	3.1	3	26
NICKEL	125	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	3.9	5.9
POTASSIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	4650	2860	5700	N/A	N/A
SELENIUM	17	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	5.1	5.1	1.1	4
SILICON	None	8	0 (0.0%)	8 (100.0%)	N/A	2460	1530	2470	N/A	N/A
SILVER	0.59	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	2	5
SODIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	45000	24000	52400	N/A	N/A
STRONTIUM	None	9	0 (0.0%)	9 (100.0%)	N/A	320	210	330	N/A	N/A
THALLIUM	15	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1.4	15
TIN	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10.4	16
VANADIUM	None	9	8 (88.9%)	1 (11.1%)	N/A	Nondetect	3.3	3.3	2	5.7
ZINC	144	9	5 (55.6%)	4 (44.4%)	0 (0.0%)	20	2.8	21	3	4.3

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POND A4 FILTERED METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	87	58	27 (46.6%)	30 (51.7%)	1 (1.7%)	34	15	800	10	66
ANTIMONY	None	59	52 (88.1%)	7 (11.9%)	N/A	Nondetect	11.7	29.6	6	54.1
ARSENIC	150	59	37 (62.7%)	22 (37.3%)	0 (0.0%)	3	1.1	4.8	0.8	4
BARIUM	None	59	0 (0.0%)	59 (100.0%)	N/A	81.6	39.2	100	N/A	N/A
BERYLLIUM	4	58	58 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.3	1.9
CADMIUM	1.5	57	54 (94.7%)	2 (3.5%)	1 (1.8%)	Nondetect	0.73	3.1	0.1	3.1
CALCIUM	None	59	0 (0.0%)	59 (100.0%)	N/A	50200	21000	58000	N/A	N/A
CESIUM	None	53	46 (86.8%)	7 (13.2%)	N/A	Nondetect	50	120	2	500
CHROMIUM	None	59	57 (96.6%)	2 (3.4%)	N/A	Nondetect	9	44.9	2	8
COBALT	None	59	53 (89.8%)	6 (10.2%)	N/A	Nondetect	1.4	3.8	1.3	8
COPPER	16	59	43 (72.9%)	16 (27.1%)	0 (0.0%)	3.4	2	13.2	1.4	11
IRON	300	59	21 (35.6%)	38 (64.4%)	0 (0.0%)	33	5.1	88.8	2	35
LEAD	6.5	59	25 (42.4%)	34 (57.6%)	0 (0.0%)	3.1	1.1	5.6	0.7	5
LITHIUM	None	54	1 (1.9%)	53 (98.1%)	N/A	13	6.1	25.6	4.5	4.5
MAGNESIUM	None	59	0 (0.0%)	59 (100.0%)	N/A	10600	7190	16300	N/A	N/A
MANGANESE	50	59	12 (20.3%)	40 (67.8%)	7 (11.9%)	34	1	274	1	1.8
MERCURY	0.01	58	51 (87.9%)	0 (0.0%)	7 (12.1%)	Nondetect	0.12	0.3	0.1	0.2
MOLYBDENUM	None	58	19 (32.8%)	39 (67.2%)	N/A	7.1	3	15.6	3	26
NICKEL	125	59	47 (79.7%)	12 (20.3%)	0 (0.0%)	3.4	2.6	23.2	2.6	21
POTASSIUM	None	59	0 (0.0%)	59 (100.0%)	N/A	9500	4980	11000	N/A	N/A
SELENIUM	17	59	49 (83.1%)	10 (16.9%)	0 (0.0%)	1	0.8	5.4	0.8	4
SILICON	None	22	0 (0.0%)	22 (100.0%)	N/A	3790	2110	5100	N/A	N/A
SILVER	0.59	59	56 (94.9%)	0 (0.0%)	3 (5.1%)	Nondetect	2.2	3.3	0.2	5
SODIUM	None	59	0 (0.0%)	59 (100.0%)	N/A	41400	27000	52000	N/A	N/A
STRONTIUM	None	58	0 (0.0%)	58 (100.0%)	N/A	289	190	402	N/A	N/A
THALLIUM	15	59	57 (96.6%)	2 (3.4%)	0 (0.0%)	Nondetect	1	1	1	20
TIN	None	54	47 (87.0%)	7 (13.0%)	N/A	Nondetect	9.3	97	6.2	136
VANADIUM	None	59	42 (71.2%)	17 (28.8%)	N/A	3.5	2.2	5.3	2	11
ZINC	144	59	6 (10.2%)	53 (89.8%)	0 (0.0%)	27.3	5.2	60.7	1.7	14.2

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POND B5 FILTERED METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	87	38	12 (31.6%)	24 (63.2%)	2 (5.3%)	56	13	144	10	66
ANTIMONY	None	40	37 (92.5%)	3 (7.5%)	N/A	Nondetect	12	18.9	6	31
ARSENIC	150	39	26 (66.7%)	13 (33.3%)	0 (0.0%)	2.9	0.7	3.5	1.5	4
BARIUM	None	39	0 (0.0%)	39 (100.0%)	N/A	78	5.3	95	N/A	N/A
BERYLLIUM	4	38	38 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.3	1
CADMIUM	1.5	36	35 (97.2%)	0 (0.0%)	1 (2.8%)	Nondetect	1.7	1.7	1	5
CALCIUM	None	39	0 (0.0%)	39 (100.0%)	N/A	44000	170	47000	N/A	N/A
CESIUM	None	37	28 (75.7%)	9 (24.3%)	N/A	50	26.7	90	30	500
CHROMIUM	None	39	36 (92.3%)	3 (7.7%)	N/A	Nondetect	2.5	6.4	2	10
COBALT	None	39	32 (82.1%)	7 (17.9%)	N/A	2.2	2.2	4	1.3	20
COPPER	16	39	28 (71.8%)	11 (28.2%)	0 (0.0%)	4.9	2.1	13.9	1.4	11
IRON	300	39	12 (30.8%)	27 (69.2%)	0 (0.0%)	47	2.7	100	7	35
LEAD	6.5	39	15 (38.5%)	24 (61.5%)	0 (0.0%)	2.6	0.8	4.3	1	4.1
LITHIUM	None	37	2 (5.4%)	35 (94.6%)	N/A	22	4.4	33	2	3
MAGNESIUM	None	39	1 (2.6%)	38 (97.4%)	N/A	8500	6170	9240	29	29
MANGANESE	50	39	0 (0.0%)	23 (59.0%)	16 (41.0%)	140	1	294	N/A	N/A
MERCURY	0.01	38	36 (94.7%)	0 (0.0%)	2 (5.3%)	Nondetect	0.23	0.27	0.1	0.2
MOLYBDENUM	None	38	14 (36.8%)	24 (63.2%)	N/A	9.9	3.5	14	3	26
NICKEL	125	39	33 (84.6%)	6 (15.4%)	0 (0.0%)	3.2	3.2	12.5	2.6	20
POTASSIUM	None	39	1 (2.6%)	38 (97.4%)	N/A	11100	6800	14000	72	72
SELENIUM	17	39	35 (89.7%)	4 (10.3%)	0 (0.0%)	Nondetect	1.1	10	1	4
SILICON	None	6	0 (0.0%)	6 (100.0%)	N/A	3410	2390	3410	N/A	N/A
SILVER	0.59	39	39 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	2	5
SODIUM	None	39	0 (0.0%)	39 (100.0%)	N/A	37000	120	39300	N/A	N/A
STRONTIUM	None	38	0 (0.0%)	38 (100.0%)	N/A	240	2.3	268	N/A	N/A
THALLIUM	15	39	37 (94.9%)	1 (2.6%)	1 (2.6%)	Nondetect	1	16	1	20
TIN	None	37	34 (91.9%)	3 (8.1%)	N/A	Nondetect	25.6	33.3	6.2	23
VANADIUM	None	39	15 (38.5%)	24 (61.5%)	N/A	5.1	2	8.7	2	11
ZINC	144	39	2 (5.1%)	37 (94.9%)	0 (0.0%)	37	9.3	59.4	7	13.6

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POND C2 FILTERED METALS SUMMARY STATISTICS

Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
ALUMINUM	87	41	20 (48.8%)	20 (48.8%)	1 (2.4%)	37	12	770	9	66
ANTIMONY	None	42	35 (83.3%)	7 (16.7%)	N/A	9.5	9.5	20.1	6	31
ARSENIC	150	42	26 (61.9%)	16 (38.1%)	0 (0.0%)	3.4	1	5.2	1.8	4
BARIUM	None	42	0 (0.0%)	42 (100.0%)	N/A	85.1	1.3	98.7	N/A	N/A
BERYLLIUM	4	40	40 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.3	1
CADMIUM	1.5	41	40 (97.6%)	0 (0.0%)	1 (2.4%)	Nondetect	4.4	4.4	0.2	3
CALCIUM	None	42	0 (0.0%)	42 (100.0%)	N/A	52900	90.7	59000	N/A	N/A
CESIUM	None	41	31 (75.6%)	10 (24.4%)	N/A	50	15.9	80	5	500
CHROMIUM	None	42	39 (92.9%)	3 (7.1%)	N/A	Nondetect	2.5	6.2	2	5.7
COBALT	None	42	42 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	1.3	4
COPPER	16	42	26 (61.9%)	15 (35.7%)	1 (2.4%)	8.2	2.6	54.8	1.9	11
IRON	300	41	16 (39.0%)	25 (61.0%)	0 (0.0%)	44.1	3.3	148	6.5	35
LEAD	6.5	42	22 (52.4%)	20 (47.6%)	0 (0.0%)	2.3	1	6.2	0.7	4
LITHIUM	None	41	1 (2.4%)	40 (97.6%)	N/A	11	5.8	13.2	2	2
MAGNESIUM	None	42	1 (2.4%)	41 (97.6%)	N/A	17900	11000	19000	12	12
MANGANESE	50	42	3 (7.1%)	25 (59.5%)	14 (33.3%)	193	1.1	970	1	1.6
MERCURY	0.01	41	36 (87.8%)	0 (0.0%)	5 (12.2%)	Nondetect	0.15	0.27	0.1	0.2
MOLYBDENUM	None	42	33 (78.6%)	9 (21.4%)	N/A	3.7	2.2	14.9	2	26
NICKEL	125	42	40 (95.2%)	2 (4.8%)	0 (0.0%)	Nondetect	4.1	19.8	2.6	11.2
POTASSIUM	None	42	1 (2.4%)	41 (97.6%)	N/A	6150	2380	7360	51	51
SELENIUM	17	42	38 (90.5%)	4 (9.5%)	0 (0.0%)	Nondetect	0.9	8.9	1	4
SILICON	None	6	0 (0.0%)	6 (100.0%)	N/A	5030	1850	5030	N/A	N/A
SILVER	0.59	42	42 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
SODIUM	None	42	0 (0.0%)	42 (100.0%)	N/A	59900	353	67900	N/A	N/A
STRONTIUM	None	42	0 (0.0%)	42 (100.0%)	N/A	411	2.2	429	N/A	N/A
THALLIUM	15	42	42 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	15
TIN	None	41	35 (85.4%)	6 (14.6%)	N/A	Nondetect	12.5	38.9	6.2	23
VANADIUM	None	42	35 (83.3%)	7 (16.7%)	N/A	2	2	4.4	2	7
ZINC	144	42	17 (40.5%)	25 (59.5%)	0 (0.0%)	11.6	2.9	16.7	2	11

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration Minimum (µg/L)	Detected Concentration Maximum (µg/L)	Nondetected Concentration Minimum (µg/L)	Nondetected Concentration Maximum (µg/L)
A1	1,1,1-TRICHLOROETHANE	200	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
A1	1,1-DICHLOROETHANE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	5
A1	1,1-DICHLOROETHENE	0.057	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A1	1,2,3-TRICHLOROBENZENE	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.1
A1	1,2,4-TRIMETHYLBENZENE	None	8	7 (87.5%)	1 (12.5%)	N/A	Nondetect	0.12	0.12	0.1	0.1
A1	1,2-DICHLOROETHENE	None	14	14 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A1	2,4-DIMETHYLPHENOL	2120	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	12
A1	2-BUTANONE	None	14	14 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A1	2-HEXANONE	None	14	14 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A1	2-METHYLNAPHTHALENE	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	12
A1	4-METHYL-2-PENTANONE	None	14	14 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A1	4-METHYLPHENOL	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	12
A1	ACENAPHTHENE	520	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9.8	18.5
A1	ACETONE	None	14	13 (92.9%)	1 (7.1%)	N/A	Nondetect	15	15	10	13
A1	ALPHA-BHC	0.0039	9	8 (88.9%)	0 (0.0%)	1 (11.1%)	Nondetect	0.01	0.01	0.049	0.056
A1	AROCLOR-1260	44E-6	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.97	1.1
A1	BENZENE	1	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A1	BETA-BHC	0.014	9	7 (77.8%)	0 (0.0%)	2 (22.2%)	0.02	0.02	0.02	0.049	0.056
A1	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	8	7 (87.5%)	0 (0.0%)	1 (12.5%)	Nondetect	2	2	10	12
A1	BROMODICHLOROMETHANE	0.3	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A1	CARBON DISULFIDE	None	14	14 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A1	CARBON TETRACHLORIDE	18	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A1	CHLOROETHANE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10
A1	CHLOROFORM	6	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
A1	CHLOROMETHANE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration Minimum (µg/L)	Detected Concentration Maximum (µg/L)	Nondetected Concentration Minimum (µg/L)	Nondetected Concentration Maximum (µg/L)
A1	CIS-1,2-DICHLOROETHENE	70	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
A1	CIS-1,3-DICHLOROPROPENE	10	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
A1	DELTA-BHC	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.049	0.056
A1	DIBENZOFURAN	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	12
A1	DICHLORODIFLUOROMETHANE	None	8	7 (87.5%)	1 (12.5%)	N/A	Nondetect	0.72	0.72	0.5	0.5
A1	DIETHYL PHTHALATE	23000	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	12
A1	ENDOSULFAN.I	0.056	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	0.01	0.01	0.049	0.056
A1	ETHYLBENZENE	680	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A1	FLUORENE	0.0028	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.88	10
A1	GAMMA-BHC(LINDANE)	0.019	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.049	0.056
A1	HEPTACHLOR	0.0002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.049	0.056
A1	M,P-XYLENES	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
A1	METHYLENE CHLORIDE	4.7	15	12 (80.0%)	3 (20.0%)	0 (0.0%)	3	3	4	2	6
A1	N-BUTYLBENZENE	None	8	7 (87.5%)	1 (12.5%)	N/A	Nondetect	0.64	0.64	0.2	0.2
A1	NAPHTHALENE	0.0028	5	5 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	3.8	7.17
A1	O-XYLENE	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
A1	PHENANTHRENE	0.0028	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.7	10
A1	TETRACHLOROETHENE	76	15	14 (93.3%)	1 (6.7%)	0 (0.0%)	Nondetect	0.07	0.07	0.04	5
A1	TOLUENE	1000	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A1	TOTAL XYLENES	None	14	14 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A1	TRANS-1,2-DICHLOROETHENE	100	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
A1	TRICHLOROETHENE	66	15	14 (93.3%)	1 (6.7%)	0 (0.0%)	Nondetect	0.3	0.3	0.04	.5
A1	VINYL ACETATE	None	11	11 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A1	VINYL CHLORIDE	2	15	15 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	10

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration Minimum (µg/L)	Detected Concentration Maximum (µg/L)	Nondetected Concentration Minimum (µg/L)	Nondetected Concentration Maximum (µg/L)
A2	1,1,1-TRICHLOROETHANE	200	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
A2	1,1-DICHLOROETHANE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	5
A2	1,1-DICHLOROETHENE	0.057	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A2	1,2,3-TRICHLOROBENZENE	None	8	7 (87.5%)	1 (12.5%)	N/A	Nondetect	0.11	0.11	0.1	0.1
A2	1,2,4-TRIMETHYLBENZENE	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.1
A2	1,2-DICHLOROETHENE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A2	2,4-DIMETHYLPHENOL	2120	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	12
A2	2-BUTANONE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A2	2-HEXANONE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A2	2-METHYLNAPHTHALENE	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	12
A2	4-METHYL-2-PENTANONE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A2	4-METHYLPHENOL	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	12
A2	ACENAPHTHENE	520	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9.41	12
A2	ACETONE	None	15	13 (86.7%)	2 (13.3%)	N/A	Nondetect	9	18	10	10
A2	ALPHA-BHC	0.0039	9	7 (77.8%)	0 (0.0%)	2 (22.2%)	0.01	0.01	0.01	0.05	0.055
A2	AROCLOR-1260	44E-6	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.99	1.1
A2	BENZENE	1	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A2	BETA-BHC	0.014	9	7 (77.8%)	0 (0.0%)	2 (22.2%)	0.021	0.021	0.021	0.05	0.055
A2	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	8	7 (87.5%)	0 (0.0%)	1 (12.5%)	Nondetect	220	220	10	12
A2	BROMODICHLOROMETHANE	0.3	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A2	CARBON DISULFIDE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A2	CARBON TETRACHLORIDE	18	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A2	CHLOROETHANE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10
A2	CHLOROFORM	6	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
A2	CHLOROMETHANE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration Minimum (µg/L)	Detected Concentration Maximum (µg/L)	Nondetected Concentration Minimum (µg/L)	Nondetected Concentration Maximum (µg/L)
A2	CIS-1,2-DICHLOROETHENE	70	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
A2	CIS-1,3-DICHLOROPROPENE	10	16	15 (93.7%)	1 (6.2%)	0 (0.0%)	Nondetect	0.41	0.41	0.1	5
A2	DELTA-BHC	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.05	0.055
A2	DIBENZOFURAN	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	12
A2	DICHLORODIFLUOROMETHANE	None	8	7 (87.5%)	1 (12.5%)	N/A	Nondetect	1.43	1.43	0.5	0.5
A2	DIETHYL PHTHALATE	23000	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	12
A2	ENDOSULFAN I	0.056	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.055
A2	ETHYLBENZENE	680	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A2	FLUORENE	0.0028	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.845	12
A2	GAMMA-BHC(LINDANE)	0.019	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.055
A2	HEPTACHLOR	0.0002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.055
A2	M,P-XYLENES	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
A2	METHYLENE CHLORIDE	4.7	16	11 (68.7%)	4 (25.0%)	1 (6.2%)	4	3	6	2	5
A2	N-BUTYLBENZENE	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
A2	NAPHTHALENE	0.0028	5	5 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	3.65	4.27
A2	O-XYLENE	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
A2	PHENANTHRENE	0.0028	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.672	12
A2	TETRACHLOROETHENE	76	16	15 (93.7%)	1 (6.2%)	0 (0.0%)	Nondetect	0.68	0.68	0.04	5
A2	TOLUENE	1000	16	15 (93.7%)	1 (6.2%)	0 (0.0%)	Nondetect	9	9	0.2	5
A2	TOTAL XYLENES	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A2	TRANS-1,2-DICHLOROETHENE	100	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
A2	TRICHLOROETHENE	66	16	13 (81.2%)	3 (18.8%)	0 (0.0%)	0.16	0.16	0.54	0.04	5
A2	VINYL ACETATE	None	12	12 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A2	VINYL CHLORIDE	2	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	10

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VOA/SVOA, HERBICIDES, & PESTICIDES SUMMARY STATISTICS

Pond	Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
A3	1,1,1-TRICHLOROETHANE	200	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	0.12	0.12	0.1	5
A3	1,1-DICHLOROETHANE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	5
A3	1,4-DICHLOROBENZENE	75	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	10
A3	2-BUTANONE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A3	2-HEXANONE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A3	4,4'-DDT	0.0006	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.11
A3	4-METHYL-2-PENTANONE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
A3	ACETONE	None	9	7 (77.8%)	2 (22.2%)	N/A	22	22	33	10	10
A3	ATRAZINE	3	7	5 (71.4%)	2 (28.6%)	0 (0.0%)	0.5	0.5	0.54	0.5	0.53
A3	BETA-BHC	0.014	9	8 (88.9%)	0 (0.0%)	1 (11.1%)	Nondetect	0.04	0.04	0.05	0.053
A3	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	1	1	10	10
A3	CARBON DISULFIDE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A3	CHLOROETHANE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10
A3	CHLOROFORM	6	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
A3	CIS-1,2-DICHLOROETHENE	70	7	7 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
A3	DI-N-BUTYL PHTHALATE	2700	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	10
A3	DIETHYL PHTHALATE	23000	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	10
A3	ETHYLBENZENE	680	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A3	METHYLENE CHLORIDE	4.7	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	2	5
A3	NAPHTHALENE	0.0028	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	10
A3	PROMETON	None	7	7 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.3	0.32
A3	PROPAZINE	None	7	7 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.3	0.32
A3	SIMAZINE	4	7	7 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.6	0.63
A3	TETRACHLOROETHENE	0.8	9	7 (77.8%)	2 (22.2%)	0 (0.0%)	0.1	0.1	0.52	0.04	5
A3	TOLUENE	1000	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
A3	TOTAL XYLENES	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
A3	TRICHLOROETHENE	2.7	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	0.04	0.04	0.04	5

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VOA/SVOA, HERBICIDES, & PESTICIDES SUMMARY STATISTICS

Pond	Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
A4	1,1,1-TRICHLOROETHANE	200	77	71 (92.2%)	6 (7.8%)	0 (0.0%)	Nondetect	0.1	0.42	0.1	5
A4	1,1-DICHLOROETHANE	None	77	76 (98.7%)	1 (1.3%)	N/A	Nondetect	2	2	0.1	5
A4	1,4-DICHLOROBENZENE	75	47	46 (97.9%)	1 (2.1%)	0 (0.0%)	Nondetect	0.5	0.5	0.1	10
A4	2,2-DICHLOROPROPANOIC ACID	None	17	16 (94.1%)	1 (5.9%)	N/A	Nondetect	0.99	0.99	5.8	10
A4	2-BUTANONE	None	49	46 (93.9%)	3 (6.1%)	N/A	Nondetect	2	10	10	100
A4	2-HEXANONE	None	49	49 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	50
A4	4,4'-DDT	0.0006	34	33 (97.1%)	0 (0.0%)	1 (2.9%)	Nondetect	0.28	0.28	0.099	1
A4	4-METHYL-2-PENTANONE	None	49	48 (98.0%)	1 (2.0%)	N/A	Nondetect	3	3	10	50
A4	ACETONE	None	49	19 (38.8%)	30 (61.2%)	N/A	11	1	97	10	100
A4	ATRAZINE	3	69	29 (42.0%)	40 (58.0%)	0 (0.0%)	0.56	0.08	1.6	0.15	0.6
A4	BETA-BHC	0.014	34	34 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.52
A4	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	38	26 (68.4%)	1 (2.6%)	11 (28.9%)	7	1	170	5	11
A4	CARBON DISULFIDE	None	49	48 (98.0%)	1 (2.0%)	N/A	Nondetect	2	2	5	5
A4	CHLOROETHANE	None	77	77 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	10
A4	CHLOROFORM	6	77	67 (87.0%)	10 (13.0%)	0 (0.0%)	Nondetect	0.08	0.55	0.1	5
A4	CIS-1,2-DICHLOROETHENE	70	43	43 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	1
A4	DI-N-BUTYL PHTHALATE	2700	38	34 (89.5%)	4 (10.5%)	0 (0.0%)	Nondetect	1	3	5	11
A4	DIETHYL PHTHALATE	23000	38	37 (97.4%)	1 (2.6%)	0 (0.0%)	Nondetect	3	3	5	11
A4	ETHYLBENZENE	680	77	75 (97.4%)	2 (2.6%)	0 (0.0%)	Nondetect	1	1	0.2	5
A4	HEXAZINONE	None	1	0 (0.0%)	1 (100.0%)	N/A	1.3	1.3	1.3	N/A	N/A
A4	METHYLENE CHLORIDE	4.7	77	67 (87.0%)	9 (11.7%)	1 (1.3%)	Nondetect	1	5	0.1	7
A4	NAPHTHALENE	0.0028	47	46 (97.9%)	0 (0.0%)	1 (2.1%)	Nondetect	0.11	0.11	0.2	10
A4	PROMETON	None	62	62 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.09	0.36
A4	PROPAZINE	None	62	61 (98.4%)	1 (1.6%)	N/A	Nondetect	0.35	0.35	0.09	0.36
A4	SIMAZINE	4	69	67 (97.1%)	2 (2.9%)	0 (0.0%)	Nondetect	0.07	0.08	0.18	0.72
A4	TETRACHLOROETHENE	0.8	77	75 (97.4%)	2 (2.6%)	0 (0.0%)	Nondetect	0.08	0.18	0.04	5
A4	TOLUENE	1000	77	74 (96.1%)	3 (3.9%)	0 (0.0%)	Nondetect	1	3.8	0.1	5
A4	TOTAL XYLENES	None	49	46 (93.9%)	3 (6.1%)	N/A	Nondetect	1	3	5	5
A4	TRICHLOROETHENE	2.7	77	72 (93.5%)	4 (5.2%)	1 (1.3%)	Nondetect	0.18	3	0.04	5

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (µg/L)	Maximum (µg/L)	Minimum (µg/L)	Maximum (µg/L)
B1	1,1,1-TRICHLOROETHANE	200	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
B1	1,1-DICHLOROETHANE	None	17	17 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	5
B1	1,1-DICHLOROETHENE	0.057	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B1	1,2,3-TRICHLOROBENZENE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.1
B1	1,2,4-TRIMETHYLBENZENE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.1
B1	1,2-DICHLOROETHENE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
B1	2,4-DIMETHYLPHENOL	2120	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	10
B1	2-BUTANONE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B1	2-HEXANONE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B1	2-METHYLNAPHTHALENE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B1	4-METHYL-2-PENTANONE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B1	4-METHYLPHENOL	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B1	ACENAPHTHENE	520	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9.9	10.2
B1	ACETONE	None	15	14 (93.3%)	1 (6.7%)	N/A	Nondetect	6	6	10	21
B1	ALPHA-BHC	0.0039	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.057
B1	AROCLOR-1260	44E-6	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.99	1.1
B1	BENZENE	1	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B1	BETA-BHC	0.014	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.057
B1	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	9	7 (77.8%)	1 (11.1%)	1 (11.1%)	1	1	4	10	10
B1	BROMODICHLOROMETHANE	0.3	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B1	CARBON DISULFIDE	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
B1	CARBON TETRACHLORIDE	18	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B1	CHLOROETHANE	None	17	17 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10
B1	CHLOROFORM	6	17	16 (94.1%)	1 (5.9%)	0 (0.0%)	Nondetect	0.2	0.2	0.1	5
B1	CHLOROMETHANE	None	17	17 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th. Percentile (µg/L)	Detected Concentration Minimum (µg/L)	Detected Concentration Maximum (µg/L)	Nondetected Concentration Minimum (µg/L)	Nondetected Concentration Maximum (µg/L)
B1	CIS-1,2-DICHLOROETHENE	70	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	0.33	0.33	0.1	0.1
B1	CIS-1,3-DICHLOROPROPENE	10	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
B1	DELTA-BHC	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.05	0.057
B1	DIBENZOFURAN	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B1	DICHLORODIFLUOROMETHANE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	0.5
B1	DIETHYL PHTHALATE	23000	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	10
B1	ENDOSULFAN I	0.056	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.057
B1	ETHYLBENZENE	680	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B1	FLUORENE	0.0028	9	8 (88.9%)	0 (0.0%)	1 (11.1%)	Nondetect	1.15	1.15	0.889	10
B1	GAMMA-BHC(LINDANE)	0.019	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.057
B1	HEPTACHLOR	0.0002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.057
B1	M,P-XYLENES	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
B1	METHYLENE CHLORIDE	4.7	17	13 (76.5%)	2 (11.8%)	2 (11.8%)	3	3	12	2	5
B1	N-BUTYLBENZENE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
B1	NAPHTHALENE	0.0028	5	5 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	3.84	3.96
B1	O-XYLENE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
B1	PHENANTHRENE	0.0028	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.707	10
B1	TETRACHLOROETHENE	76	17	15 (88.2%)	2 (11.8%)	0 (0.0%)	Nondetect	0.06	0.44	0.04	5
B1	TOLUENE	1000	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B1	TOTAL XYLENES	None	16	16 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
B1	TRANS-1,2-DICHLOROETHENE	100	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
B1	TRICHLOROETHENE	66	17	15 (88.2%)	2 (11.8%)	0 (0.0%)	Nondetect	0.47	0.48	0.04	5
B1	VINYL ACETATE	None	13	13 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B1	VINYL CHLORIDE	2	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	10

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration Minimum (µg/L)	Detected Concentration Maximum (µg/L)	Nondetected Concentration Minimum (µg/L)	Nondetected Concentration Maximum (µg/L)
B2	1,1,1-TRICHLOROETHANE	200	21	19 (90.5%)	2 (9.5%)	0 (0.0%)	Nondetect	0.15	0.53	0.1	5
B2	1,1-DICHLOROETHANE	None	21	21 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	5
B2	1,1-DICHLOROETHENE	0.057	21	20 (95.2%)	0 (0.0%)	1 (4.8%)	Nondetect	0.24	0.24	0.2	5
B2	1,2,3-TRICHLOROBENZENE	None	10	10 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.5
B2	1,2,4-TRIMETHYLBENZENE	None	10	10 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.5
B2	1,2-DICHLOROETHENE	None	19	10 (52.6%)	9 (47.4%)	N/A	6	4	23	5	5
B2	2,4-DIMETHYLPHENOL	2120	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	10
B2	2-BUTANONE	None	19	19 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B2	2-HEXANONE	None	19	19 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B2	2-METHYLNAPHTHALENE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B2	4-METHYL-2-PENTANONE	None	19	19 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B2	4-METHYLPHENOL	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B2	ACENAPHTHENE	520	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9.8	10.3
B2	ACETONE	None	19	16 (84.2%)	3 (15.8%)	N/A	17	17	150	10	22
B2	ALPHA-BHC	0.0039	8	6 (75.0%)	0 (0.0%)	2 (25.0%)	0.01	0.01	0.01	0.048	0.053
B2	AROCLOR-1260	44E-6	8	7 (87.5%)	0 (0.0%)	1 (12.5%)	Nondetect	0.34	0.34	0.96	1.1
B2	BENZENE	1	21	21 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B2	BETA-BHC	0.014	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.048	0.053
B2	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	9	6 (66.7%)	1 (11.1%)	2 (22.2%)	2	1	3	10	10
B2	BROMODICHLOROMETHANE	0.3	21	20 (95.2%)	0 (0.0%)	1 (4.8%)	Nondetect	0.44	0.44	0.2	5
B2	CARBON DISULFIDE	None	19	19 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
B2	CARBON TETRACHLORIDE	18	21	11 (52.4%)	10 (47.6%)	0 (0.0%)	7	1	18	0.2	5
B2	CHLOROETHANE	None	21	21 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10
B2	CHLOROFORM	6	21	8 (38.1%)	12 (57.1%)	1 (4.8%)	4.1	0.1	8	5	5
B2	CHLOROMETHANE	None	21	21 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration Minimum (µg/L)	Detected Concentration Maximum (µg/L)	Nondetected Concentration Minimum (µg/L)	Nondetected Concentration Maximum (µg/L)
B2	CIS-1,2-DICHLOROETHENE	70	10	1 (10.0%)	9 (90.0%)	0 (0.0%)	5	1.2	7.3	0.1	0.1
B2	CIS-1,3-DICHLOROPROPENE	10	21	21 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
B2	DELTA-BHC	None	8	8 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.048	0.053
B2	DIBENZOFURAN	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B2	DICHLORODIFLUOROMETHANE	None	10	10 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	0.5
B2	DIETHYL PHTHALATE	23000	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	10	10
B2	ENDOSULFAN I	0.056	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.048	0.053
B2	ETHYLBENZENE	680	21	21 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B2	FLUORENE	0.0028	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.88	10
B2	GAMMA-BHC(LINDANE)	0.019	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.048	0.053
B2	HEPTACHLOR	0.0002	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.048	0.053
B2	M,P-XYLENES	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
B2	METHYLENE CHLORIDE	4.7	21	16 (76.2%)	3 (14.3%)	2 (9.5%)	4	3	13	0.6	11
B2	N-BUTYLBENZENE	None	10	10 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.5
B2	NAPHTHALENE	0.0028	5	4 (80.0%)	0 (0.0%)	1 (20.0%)	3	3	3	3.8	3.99
B2	O-XYLENE	None	10	10 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.5
B2	PHENANTHRENE	0.0028	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.7	10
B2	TETRACHLOROETHENE	76	21	7 (33.3%)	14 (66.7%)	0 (0.0%)	5	0.12	9	5	5
B2	TOLUENE	1000	21	19 (90.5%)	2 (9.5%)	0 (0.0%)	Nondetect	0.5	0.8	0.2	5
B2	TOTAL XYLENES	None	19	19 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
B2	TRANS-1,2-DICHLOROETHENE	100	10	8 (80.0%)	2 (20.0%)	0 (0.0%)	0.13	0.13	0.32	0.1	0.5
B2	TRICHLOROETHENE	66	21	1 (4.8%)	17 (81.0%)	3 (14.3%)	60.6	1.9	170	5	5
B2	VINYL ACETATE	None	15	15 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
B2	VINYL CHLORIDE	2	21	19 (90.5%)	2 (9.5%)	0 (0.0%)	Nondetect	0.2	0.94	0.2	10

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VOA/SVOA, HERBICIDES, & PESTICIDES SUMMARY STATISTICS

Pond	Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
B5	1,1,1-TRICHLOROETHANE	200	60	58 (96.7%)	2 (3.3%)	0 (0.0%)	Nondetect	0.3	12	0.1	5
B5	1,1-DICHLOROETHANE	None	60	60 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	5
B5	1,4-DICHLOROBENZENE	75	25	24 (96.0%)	1 (4.0%)	0 (0.0%)	Nondetect	0.4	0.4	0.1	10
B5	2,2-DICHLOROPROPANOIC ACID	None	12	12 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5.8	10
B5	2-BUTANONE	None	50	43 (86.0%)	7 (14.0%)	N/A	Nondetect	1	2	10	100
B5	2-HEXANONE	None	50	50 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	50
B5	4,4'-DDT	0.0006	20	18 (90.0%)	0 (0.0%)	2 (10.0%)	Nondetect	0.25	0.58	0.1	0.22
B5	4-METHYL-2-PENTANONE	None	50	50 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	50
B5	ACETONE	None	50	18 (36.0%)	32 (64.0%)	N/A	12	1	92	10	100
B5	ATRAZINE	3	47	10 (21.3%)	37 (78.7%)	0 (0.0%)	0.71	0.07	1.9	0.15	0.55
B5	BETA-BHC	0.014	20	20 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.11
B5	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	21	16 (76.2%)	2 (9.5%)	3 (14.3%)	1	0.7	20	10	10
B5	CARBON DISULFIDE	None	50	50 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
B5	CHLOROETHANE	None	60	60 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	10
B5	CHLOROFORM	6	60	47 (78.3%)	12 (20.0%)	1 (1.7%)	0.345	0.19	8	0.1	5
B5	CIS-1,2-DICHLOROETHENE	70	22	21 (95.5%)	1 (4.5%)	0 (0.0%)	Nondetect	0.2	0.2	0.1	1
B5	DI-N-BUTYL PHTHALATE	2700	21	20 (95.2%)	1 (4.8%)	0 (0.0%)	Nondetect	1	1	5	10
B5	DIETHYL PHTHALATE	23000	21	21 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	5	10
B5	ETHYLBENZENE	680	60	60 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
B5	METHYLENE CHLORIDE	4.7	60	48 (80.0%)	11 (18.3%)	1 (1.7%)	1.9	1	10	0.1	20
B5	NAPHTHALENE	0.0028	25	25 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	10
B5	PROMETON	None	45	45 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.09	0.33
B5	PROPAZINE	None	45	44 (97.8%)	1 (2.2%)	N/A	Nondetect	0.42	0.42	0.09	0.33
B5	SIMAZINE	4	47	45 (95.7%)	2 (4.3%)	0 (0.0%)	Nondetect	0.18	0.25	0.18	0.66
B5	TETRACHLOROETHENE	0.8	60	59 (98.3%)	1 (1.7%)	0 (0.0%)	Nondetect	0.3	0.3	0.04	5
B5	TOLUENE	1000	60	60 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
B5	TOTAL XYLENES	None	50	49 (98.0%)	1 (2.0%)	N/A	Nondetect	1	1	5	5
B5	TRICHLOROETHENE	2.7	60	55 (91.7%)	5 (8.3%)	0 (0.0%)	Nondetect	0.1	0.73	0.1	5

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VOA/SVOA, HERBICIDES, & PESTICIDES SUMMARY STATISTICS

Pond	Analyte	Segment 4 Standard (ug/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (ug/L)	Detected Concentration Min. (ug/L)	Detected Concentration Max. (ug/L)	Nondetected Concentration Min. (ug/L)	Nondetected Concentration Max. (ug/L)
C2	1,1,1-TRICHLOROETHANE	200	53	51 (96.2%)	2 (3.8%)	0 (0.0%)	Nondetect	0.2	0.4	0.1	5
C2	1,1-DICHLOROETHANE	None	53	53 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	5
C2	1,4-DICHLOROBENZENE	75	24	24 (100.0%)	0 (. 0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	10
C2	2,2-DICHLOROPROPANOIC ACID	None	10	10 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5.8	10
C2	2-BUTANONE	None	47	40 (85.1%)	7 (14.9%)	N/A	Nondetect	1	8	10	100
C2	2-HEXANONE	None	47	45 (95.7%)	2 (4.3%)	N/A	Nondetect	2	2	10	50
C2	4,4'-DDT	0.0006	19	18 (94.7%)	0 (0.0%)	1 (5.3%)	Nondetect	0.01	0.01	0.098	0.5
C2	4-METHYL-2-PENTANONE	None	47	47 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	50
C2	ACETONE	None	47	20 (42.6%)	27 (57.4%)	N/A	6	1	22	10	100
C2	ATRAZINE	3	47	31 (66.0%)	16 (34.0%)	0 (0.0%)	0.33	0.15	0.77	0.15	0.56
C2	BETA-BHC	0.014	19	19 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.049	0.25
C2	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	23	17 (73.9%)	2 (8.7%)	4 (17.4%)	2	0.6	23	10	11
C2	CARBON DISULFIDE	None	47	47 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
C2	CHLOROETHANE	None	53	52 (98.1%)	1 (1.9%)	N/A	Nondetect	1	1	0.2	10
C2	CHLOROFORM	6	53	53 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
C2	CIS-1,2-DICHLOROETHENE	70	19	19 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	1
C2	DI-N-BUTYL PHTHALATE	2700	23	21 (91.3%)	2 (8.7%)	0 (0.0%)	Nondetect	1	2	5	11
C2	DIETHYL PHTHALATE	23000	23	23 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	5	11
C2	ETHYLBENZENE	680	53	53 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
C2	METHYLENE CHLORIDE	4.7	53	44 (83.0%)	6 (11.3%)	3 (5.7%)	1	1	80	1	24
C2	NAPHTHALENE	0.0028	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	10
C2	PROMETON	None	47	46 (97.9%)	1 (2.1%)	N/A	Nondetect	0.31	0.31	0.09	0.33
C2	PROPAZINE	None	47	47 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.09	0.33
C2	SIMAZINE	4	47	47 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.18	0.67
C2	TETRACHLOROETHENE	0.8	53	52 (98.1%)	1 (1.9%)	0 (0.0%)	Nondetect	0.55	0.55	0.04	5
C2	TOLUENE	1000	53	52 (98.1%)	1 (1.9%)	0 (0.0%)	Nondetect	3	3	0.2	5
C2	TOTAL XYLENES	None	47	45 (95.7%)	2 (4.3%)	N/A	Nondetect	1.3	3	5	5
C2	TRICHLOROETHENE	2.7	53	52 (98.1%)	1 (1.9%)	0 (0.0%)	Nondetect	0.19	0.19	0.04	5

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (µg/L)	Maximum (µg/L)	Minimum (µg/L)	Maximum (µg/L)
SW098	1,1,1-TRICHLOROETHANE	200	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
SW098	1,1-DICHLOROETHANE	None	24	24 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	5
SW098	1,1-DICHLOROETHENE	0.057	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
SW098	1,2,3-TRICHLOROBENZENE	None	2	2 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.1
SW098	1,2,4-TRIMETHYLBENZENE	None	2	2 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.1	0.1
SW098	1,2-DICHLOROETHENE	None	22	22 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
SW098	2,4-DIMETHYLPHENOL	2120	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9	11
SW098	2-BUTANONE	None	22	22 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
SW098	2-HEXANONE	None	22	22 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
SW098	2-METHYLNAPHTHALENE	None	4	4 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	9	11
SW098	4-METHYL-2-PENTANONE	None	22	22 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	10	10
SW098	4-METHYLPHENOL	None	4	4 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	9	11
SW098	ACENAPHTHENE	520	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9	11
SW098	ACETONE	None	22	20 (90.9%)	2 (9.1%)	N/A	Nondetect	6	12	10	58
SW098	ALPHA-BHC	0.0039	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.054
SW098	AROCLOR-1260	44E-6	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.99	1.1
SW098	BENZENE	1	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
SW098	BETA-BHC	0.014	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.054
SW098	BIS(2-ETHYLHEXYL)PHTHALATE	1.8	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9	11
SW098	BROMODICHLOROMETHANE	0.3	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
SW098	CARBON DISULFIDE	None	22	21 (95.5%)	1 (4.5%)	N/A	Nondetect	2	2	5	5
SW098	CARBON TETRACHLORIDE	18	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
SW098	CHLOROETHANE	None	24	24 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10
SW098	CHLOROFORM	6	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5

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VOLATILES, SEMI-VOLATILES, AND PESTICIDES SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (µg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (µg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (µg/L)	Maximum (µg/L)	Minimum (µg/L)	Maximum (µg/L)
SW098	CHLOROMETHANE	None	24	24 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	10
SW098	CIS-1,2-DICHLOROETHENE	70	2	2 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
SW098	CIS-1,3-DICHLOROPROPENE	10	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
SW098	DELTA-BHC	None	4	4 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.05	0.054
SW098	DIBENZOFURAN	None	4	4 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	9	11
SW098	DICHLORODIFLUOROMETHANE	None	2	2 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.5	0.5
SW098	DIETHYL PHTHALATE	23000	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9	11
SW098	ENDOSULFAN I	0.056	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.054
SW098	ETHYLBENZENE	680	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
SW098	FLUORENE	0.0028	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9	11
SW098	GAMMA-BHC(LINDANE)	0.019	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.054
SW098	HEPTACHLOR	0.0002	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.05	0.054
SW098	M,P-XYLENES	None	1	1 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
SW098	METHYLENE CHLORIDE	4.7	24	19 (79.2%)	2 (8.3%)	3 (12.5%)	4	3	8	2	5
SW098	N-BUTYLBENZENE	None	2	2 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
SW098	O-XYLENE	None	2	2 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.2	0.2
SW098	PHENANTHRENE	0.0028	4	4 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	9	11
SW098	TETRACHLOROETHENE	76	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
SW098	TOLUENE	1000	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	5
SW098	TOTAL XYLENES	None	22	22 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	5
SW098	TRANS-1,2-DICHLOROETHENE	100	2	2 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
SW098	TRICHLOROETHENE	66	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	5
SW098	VINYL ACETATE	None	22	21 (95.5%)	1 (4.5%)	N/A	Nondetect	80	80	10	10
SW098	VINYL CHLORIDE	2	24	24 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.2	10

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WATER QUALITY PARAMETERS SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Maximum (mg/L)
A1	AMMONIA	None	7	0 (0.0%)	7 (100.0%)	N/A	0.52	0.34	0.57	N/A	N/A
A1	BICARBONATE	None	9	0 (0.0%)	9 (100.0%)	N/A	253	70.1	257	N/A	N/A
A1	CARBONATE	None	9	0 (0.0%)	9 (100.0%)	N/A	121	49	230	N/A	N/A
A1	CHLORIDE	250	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	156	99	162	N/A	N/A
A1	CYANIDE	0.005	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.02
A1	DISSOLVED ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	17	12	17	N/A	N/A
A1	FLUORIDE	2	7	0 (0.0%)	1 (14.3%)	6 (85.7%)	3.6	1.7	4.1	N/A	N/A
A1	NITRATE	10	3	3 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.02	0.02
A1	NITRATE, AS NITROGEN	10	5	3 (60.0%)	2 (40.0%)	0 (0.0%)	0.05	0.02	0.05	0.02	0.02
A1	NITRATE/NITRITE	10	13	9 (69.2%)	4 (30.8%)	0 (0.0%)	0.1	0.04	0.37	0.02	0.1
A1	NITRATE/NITRITE, AS NITROGEN	10	1	1 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect.	N/A	N/A	0.1	0.1
A1	NITRITE	0.5	7	6 (85.7%)	1 (14.3%)	0 (0.0%)	Nondetect	0.03	0.03	0.02	0.02
A1	NITRITE, AS NITROGEN	0.5	9	8 (88.9%)	1 (11.1%)	0 (0.0%)	Nondetect	0.03	0.03	0.02	0.02
A1	OIL AND GREASE	None	10	8 (80.0%)	2 (20.0%)	N/A	7	7	8.2	5	7.6
A1	ORTHOPHOSPHATE	None	9	8 (88.9%)	1 (11.1%)	N/A	Nondetect	0.084	0.084	0.05	0.05
A1	PHOSPHORUS	None	9	3 (33.3%)	6 (66.7%)	N/A	0.086	0.056	0.12	0.05	0.05
A1	SULFATE	250	9	0 (0.0%)	8 (88.9%)	1 (11.1%)	173	77.9	368	N/A	N/A
A1	SULFIDE	0.002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	1
A1	TOTAL DISSOLVED SOLIDS	None	13	0 (0.0%)	13 (100.0%)	N/A	802	518	898	N/A	N/A
A1	TOTAL ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	19	12	19	N/A	N/A
A1	TOTAL SUSPENDED SOLIDS	None	9	1 (11.1%)	8 (88.9%)	N/A	18	5	26	5	5

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WATER QUALITY PARAMETERS SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Maximum (mg/L)
A2	AMMONIA	None	8	1 (12.5%)	7 (87.5%)	N/A	0.78	0.23	1.8	0.2	0.2
A2	BICARBONATE	None	9	0 (0.0%)	9 (100.0%)	N/A	245	170	255	N/A	N/A
A2	CARBONATE	None	9	1 (11.1%)	8 (88.9%)	N/A	70.6	27	80.3	10	10
A2	CHLORIDE	250	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	137	102	140	N/A	N/A
A2	CYANIDE	0.005	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.02
A2	DISSOLVED ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	18	4	18	N/A	N/A
A2	FLUORIDE	2	7	0 (0.0%)	0 (0.0%)	7 (100.0%)	2.9	2.2	3.1	N/A	N/A
A2	NITRATE	10	3	3 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.02	0.02
A2	NITRATE, AS NITROGEN	10	6	4 (66.7%)	2 (33.3%)	0 (0.0%)	0.04	0.02	0.04	0.02	0.02
A2	NITRATE/NITRITE	10	13	7 (53.8%)	6 (46.2%)	0 (0.0%)	0.17	0.04	0.19	0.02	0.1
A2	NITRATE/NITRITE, AS NITROGEN	10	1	1 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.1	0.1
A2	NITRITE	0.5	7	7 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.02	0.02
A2	NITRITE, AS NITROGEN	0.5	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.02	0.02
A2	OIL AND GREASE	None	9	6 (66.7%)	3 (33.3%)	N/A	7.6	6.1	8.8	5	9.4
A2	ORTHOPHOSPHATE	None	9	3 (33.3%)	6 (66.7%)	N/A	0.094	0.051	0.11	0.05	0.05
A2	PHOSPHORUS	None	10	0 (0.0%)	10 (100.0%)	N/A	0.21	0.05	0.27	N/A	N/A
A2	SULFATE	250	10	0 (0.0%)	9 (90.0%)	1 (10.0%)	212	11.1	360	N/A	N/A
A2	SULFIDE	0.002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	1
A2	TOTAL DISSOLVED SOLIDS	None	14	0 (0.0%)	14 (100.0%)	N/A	742	632	884	N/A	N/A
A2	TOTAL ORGANIC CARBON	None	6	0 (0.0%)	6 (100.0%)	N/A	26	19	26	N/A	N/A
A2	TOTAL SUSPENDED SOLIDS	None	10	4 (40.0%)	6 (60.0%)	N/A	13	6	20	4	5

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POND A3 WATER QUALITY PARAMETERS SUMMARY STATISTICS

Analyte	Segment 4 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration Min. (mg/L)	Detected Concentration Max. (mg/L)	Nondetected Concentration Min. (mg/L)	Nondetected Concentration Max. (mg/L)
AMMONIA	0.1	8	0 (0.0%)	0 (0.0%)	8 (100.0%)	0.66	0.13	1.1	N/A	N/A
BICARBONATE AS CACO3	None	8	0 (0.0%)	8 (100.0%)	N/A	144	89.8	153	N/A	N/A
CARBONATE	None	8	7 (87.5%)	1 (12.5%)	N/A	Nondetect	31.5	31.5	10	10
CHLORIDE	250	8	0 (0.0%)	8 (100.0%)	0 (0.0%)	59	27.2	80.6	N/A	N/A
CYANIDE	0.005	8	8 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.02
DISSOLVED ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	6	4	6	N/A	N/A
FLUORIDE	2	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	0.44	0.32	0.46	N/A	N/A
HEXAVALENT CHROMIUM	11	7	7 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.02
NITRATE	10	8	0 (0.0%)	8 (100.0%)	0 (0.0%)	1.8	0.81	2.1	N/A	N/A
NITRATE/NITRITE	10	16	0 (0.0%)	16 (100.0%)	0 (0.0%)	2.42	0.26	2.98	N/A	N/A
NITRITE	0.5	10	1 (10.0%)	8 (80.0%)	1 (10.0%)	0.043	0.02	0.78	0.02	0.02
OIL AND GREASE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5	6.6
ORTHOPHOSPHATE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.05	0.05
PHOSPHORUS	None	10	9 (90.0%)	1 (10.0%)	N/A	Nondetect	0.05	0.05	0.05	0.05
SULFATE	250	10	0 (0.0%)	10 (100.0%)	0 (0.0%)	48.4	19.2	52.6	N/A	N/A
SULFIDE	0.002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	1
TOTAL DISSOLVED SOLIDS	None	23	0 (0.0%)	23 (100.0%)	N/A	316	200	358	N/A	N/A
TOTAL ORGANIC CARBON	None	6	0 (0.0%)	6 (100.0%)	N/A	8	5	8	N/A	N/A
TOTAL SUSPENDED SOLIDS	None	13	2 (15.4%)	11 (84.6%)	N/A	19	5	34	5	5

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POND A4 WATER QUALITY PARAMETERS SUMMARY STATISTICS

Analyte	Segment 4 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration Min. (mg/L)	Detected Concentration Max. (mg/L)	Nondetected Concentration Min. (mg/L)	Nondetected Concentration Max. (mg/L)
ALKALINITY AS CACO3	None	36	0 (0.0%)	36 (100.0%)	N/A	135	70	148	N/A	N/A
AMMONIA	0.1	67	2 (3.0%)	0 (0.0%)	65 (97.0%)	7.7	0.9	14	0.5	0.5
BICARBONATE AS CACO3	None	59	1 (1.7%)	58 (98.3%)	N/A	135	0	148	10	10
CARBONATE	None	59	53 (89.8%)	6 (10.2%)	N/A	Nondetect	8	37.7	1	10
CHEMICAL OXYGEN DEMAND	None	1	0 (0.0%)	1 (100.0%)	N/A	38	38	38	N/A	N/A
CHLORIDE	250	60	1 (1.7%)	59 (98.3%)	0 (0.0%)	59.15	10	73	2	2
CYANIDE	0.005	32	24 (75.0%)	1 (3.1%)	7 (21.9%)	0.015	0.0026	0.0233	0.003	0.05
DISSOLVED ORGANIC CARBON	None	19	0 (0.0%)	19 (100.0%)	N/A	6	4	7	N/A	N/A
FLUORIDE	2	61	35 (57.4%)	26 (42.6%)	0 (0.0%)	0.49	0.345	0.74	0.1	0.5
HARDNESS (as CaCO3)	None	1	1 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	1	1
HARDNESS, TOTAL	None	55	0 (0.0%)	55 (100.0%)	N/A	170	0	188	N/A	N/A
HEXAVALENT CHROMIUM	11	43	41 (95.3%)	2 (4.7%)	0 (0.0%)	Nondetect	0.02	0.04	0.01	0.02
NITRATE	10	35	0 (0.0%)	35 (100.0%)	0 (0.0%)	3.12	1.52	3.48	N/A	N/A
NITRATE/NITRITE	10	85	3 (3.5%)	82 (96.5%)	0 (0.0%)	3.28	0.04	4.1	0.02	0.02
NITRITE	0.5	43	2 (4.7%)	40 (93.0%)	1 (2.3%)	0.31	0.05	0.52	0.01	0.05
OIL AND GREASE	None	16	13 (81.2%)	3 (18.8%)	N/A	6.2	6.2	25	5	10
ORTHOPHOSPHATE	None	39	26 (66.7%)	13 (33.3%)	N/A	0.03	0.01	0.13	0.01	0.05
PHOSPHORUS	None	20	1 (5.0%)	19 (95.0%)	N/A	0.14	0.02	0.25	0.05	0.05
SILICA	None	1	0 (0.0%)	1 (100.0%)	N/A	3.2	3.2	3.2	N/A	N/A
SILICON	None	2	0 (0.0%)	2 (100.0%)	N/A	4	4	4	N/A	N/A
SULFATE	250	58	1 (1.7%)	57 (98.3%)	0 (0.0%)	69	35	99	10	10
SULFIDE	0.002	27	23 (85.2%)	0 (0.0%)	4 (14.8%)	Nondetect	0.279	36	1	1
TOTAL ALKALINITY	None	3	1 (33.3%)	2 (66.7%)	N/A	148	132	148	132	132
TOTAL DISSOLVED SOLIDS	None	118	3 (2.5%)	115 (97.5%)	N/A	346	1	2630	2	10
TOTAL ORGANIC CARBON	None	20	0 (0.0%)	20 (100.0%)	N/A	12.3	5	20	N/A	N/A
TOTAL SUSPENDED SOLIDS	None	119	13 (10.9%)	106 (89.1%)	N/A	28	0	964	2	5
TOTAL VOLATILE SUSPENDED	None	2	0 (0.0%)	2 (100.0%)	N/A	11	9	11	N/A	N/A

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WATER QUALITY PARAMETERS SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Maximum (mg/L)
B1	AMMONIA	None	7	0 (0.0%)	7 (100.0%)	N/A	0.67	0.29	3.2	N/A	N/A
B1	BICARBONATE	None	9	0 (0.0%)	9 (100.0%)	N/A	150	29.7	181	N/A	N/A
B1	CARBONATE	None	9	1 (11.1%)	8 (88.9%)	N/A	89.3	12.2	106	10	10
B1	CHLORIDE	250	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	89.7	48.3	98.8	N/A	N/A
B1	CYANIDE	0.005	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.02
B1	DISSOLVED ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	14	9	14	N/A	N/A
B1	FLUORIDE	2	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	1	0.7	1.1	N/A	N/A
B1	NITRATE	10	3	3 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.02	0.05
B1	NITRATE, AS NITROGEN	10	6	2 (33.3%)	4 (66.7%)	0 (0.0%)	0.22	0.02	0.22	0.02	0.02
B1	NITRATE/NITRITE	10	12	8 (66.7%)	4 (33.3%)	0 (0.0%)	0.22	0.02	0.28	0.02	0.1
B1	NITRATE/NITRITE, AS NITROGEN	10	2	1 (50.0%)	1 (50.0%)	0 (0.0%)	0.15	0.15	0.15	0.1	0.1
B1	NITRITE	0.5	7	5 (71.4%)	2 (28.6%)	0 (0.0%)	0.025	0.025	0.084	0.02	0.02
B1	NITRITE, AS NITROGEN	0.5	9	7 (77.8%)	2 (22.2%)	0 (0.0%)	0.025	0.025	0.084	0.02	0.02
B1	OIL AND GREASE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	5.1	6.3
B1	ORTHOPHOSPHATE	None	9	3 (33.3%)	6 (66.7%)	N/A	0.16	0.052	0.17	0.05	0.05
B1	PHOSPHATE	None	1	0 (0.0%)	1 (100.0%)	N/A	0.19	0.19	0.19	N/A	N/A
B1	PHOSPHORUS	None	9	1 (11.1%)	8 (88.9%)	N/A	0.19	0.067	0.23	0.05	0.05
B1	SULFATE	250	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	47.8	15.9	71.2	N/A	N/A
B1	SULFIDE	0.002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	1
B1	TOTAL DISSOLVED SOLIDS	None	13	0 (0.0%)	13 (100.0%)	N/A	496	230	508	N/A	N/A
B1	TOTAL ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	15	11	15	N/A	N/A
B1	TOTAL SUSPENDED SOLIDS	None	9	6 (66.7%)	3 (33.3%)	N/A	13	6	15	5	5

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WATER QUALITY PARAMETERS SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Maximum (mg/L)
B2	AMMONIA	None	7	0 (0.0%)	7 (100.0%)	N/A	0.78	0.3	0.98	N/A	N/A
B2	BICARBONATE	None	9	0 (0.0%)	9 (100.0%)	N/A	226	12.7	256	N/A	N/A
B2	CARBONATE	None	9	4 (44.4%)	5 (55.6%)	N/A	121	59.3	166	10	10
B2	CHLORIDE	250	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	82.6	66.2	88.6	N/A	N/A
B2	CYANIDE	0.005	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.02
B2	DISSOLVED ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	16	10	16	N/A	N/A
B2	FLUORIDE	2	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	1.2	0.99	1.2	N/A	N/A
B2	NITRATE	10	2	1 (50.0%)	1 (50.0%)	0 (0.0%)	0.09	0.09	0.09	0.02	0.02
B2	NITRATE, AS NITROGEN	10	6	1 (16.7%)	5 (83.3%)	0 (0.0%)	0.31	0.02	0.31	0.02	0.02
B2	NITRATE/NITRITE	10	14	8 (57.1%)	6 (42.9%)	0 (0.0%)	0.45	0.03	0.58	0.02	0.1
B2	NITRATE/NITRITE, AS NITROGEN	10	2	1 (50.0%)	1 (50.0%)	0 (0.0%)	0.58	0.58	0.58	0.1	0.1
B2	NITRITE	0.5	7	7 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.02	0.02
B2	NITRITE, AS NITROGEN	0.5	9	7 (77.8%)	2 (22.2%)	0 (0.0%)	0.026	0.026	0.03	0.02	0.02
B2	OIL AND GREASE	None	9	8 (88.9%)	1 (11.1%)	N/A	Nondetect	9.3	9.3	5	6.5
B2	ORTHOPHOSPHATE	None	9	9 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.05	0.05
B2	PHOSPHATE	None	1	0 (0.0%)	1 (100.0%)	N/A	0.093	0.093	0.093	N/A	N/A
B2	PHOSPHORUS	None	9	2 (22.2%)	7 (77.8%)	N/A	0.14	0.052	0.17	0.05	0.05
B2	SULFATE	250	9	0 (0.0%)	9 (100.0%)	0 (0.0%)	38	11.8	49	N/A	N/A
B2	SULFIDE	0.002	9	9 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	1
B2	TOTAL DISSOLVED SOLIDS	None	13	0 (0.0%)	13 (100.0%)	N/A	468	312	501	N/A	N/A
B2	TOTAL ORGANIC CARBON	None	5	0 (0.0%)	5 (100.0%)	N/A	22	13	22	N/A	N/A
B2	TOTAL SUSPENDED SOLIDS	None	9	2 (22.2%)	7 (77.8%)	N/A	18	6	27	5	5

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POND B5 WATER QUALITY PARAMETERS SUMMARY STATISTICS

Analyte	Segment 4 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration Min. (mg/L)	Detected Concentration Max. (mg/L)	Nondetected Concentration Min. (mg/L)	Nondetected Concentration Max. (mg/L)
ALKALINITY AS CACO3	None	36	0 (0.0%)	36 (100.0%)	N/A	135	80	189	N/A	N/A
AMMONIA	0.1	52	2 (3.8%)	0 (0.0%)	50 (96.2%)	14	0.8	24	0.05	0.05
BICARBONATE AS CACO3	None	49	1 (2.0%)	48 (98.0%)	N/A	126	76.6	189	10	10
CARBONATE	None	49	49 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	1	10
CHEMICAL OXYGEN DEMAND	None	1	0 (0.0%)	1 (100.0%)	N/A	34	34	34	N/A	N/A
CHLORIDE	250	50	1 (2.0%)	49 (98.0%)	0 (0.0%)	55	15	63	2	2
CYANIDE	0.005	18	10 (55.6%)	1 (5.6%)	7 (38.9%)	0.0294	0.005	0.0332	0.003	0.02
DISSOLVED ORGANIC CARBON	None	19	0 (0.0%)	19 (100.0%)	N/A	7	4	8.7	N/A	N/A
FLUORIDE	2	51	30 (58.8%)	21 (41.2%)	0 (0.0%)	0.5	0.32	0.7	0.1	0.5
HARDNESS (as CaCO3)	None	1	0 (0.0%)	1 (100.0%)	N/A	120	120	120	N/A	N/A
HARDNESS, TOTAL	None	54	0 (0.0%)	54 (100.0%)	N/A	169	109	195	N/A	N/A
HEXAVALENT CHROMIUM	11	44	42 (95.5%)	2 (4.5%)	0 (0.0%)	Nondetect	0.01	0.03	0.01	0.02
NITRATE	10	40	0 (0.0%)	40 (100.0%)	0 (0.0%)	4.555	2.21	5.44	N/A	N/A
NITRATE/NITRITE	10	62	5 (8.1%)	57 (91.9%)	0 (0.0%)	3.9	1.3	5	0.02	0.1
NITRITE	0.5	43	1 (2.3%)	34 (79.1%)	8 (18.6%)	0.59	0.01	0.96	0.01	0.01
OIL AND GREASE	None	16	13 (81.2%)	3 (18.8%)	N/A	7.8	7.8	16	5	10
ORTHOPHOSPHATE	None	43	26 (60.5%)	17 (39.5%)	N/A	0.08	0.01	0.38	0.01	0.1
PHOSPHORUS	None	21	3 (14.3%)	18 (85.7%)	N/A	0.22	0.02	0.29	0.01	0.01
SILICA	None	1	0 (0.0%)	1 (100.0%)	N/A	3.4	3.4	3.4	N/A	N/A
SILICON	None	3	0 (0.0%)	3 (100.0%)	N/A	5	4	5	N/A	N/A
SULFATE	250	49	1 (2.0%)	48 (98.0%)	0 (0.0%)	77	34	120	10	10
SULFIDE	0.002	17	17 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	1	1
TOTAL ALKALINITY	None	3	0 (0.0%)	3 (100.0%)	N/A	125	120	125	N/A	N/A
TOTAL DISSOLVED SOLIDS	None	106	1 (0.9%)	105 (99.1%)	N/A	345	125	578	2	2
TOTAL ORGANIC CARBON	None	20	1 (5.0%)	19 (95.0%)	N/A	9	6	10	5	5
TOTAL SUSPENDED SOLIDS	None	107	11 (10.3%)	96 (89.7%)	N/A	32	2	210	2	5
TOTAL VOLATILE SUSPENDED	None	2	0 (0.0%)	2 (100.0%)	N/A	33	12	33	N/A	N/A

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POND C2 WATER QUALITY PARAMETERS SUMMARY STATISTICS

Analyte	Segment 4 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration Min. (mg/L)	Detected Concentration Max. (mg/L)	Nondetected Concentration Min. (mg/L)	Nondetected Concentration Max. (mg/L)
ALKALINITY AS CACO3	None	36	0 (0.0%)	36 (100.0%)	N/A	205	102	210	N/A	N/A
AMMONIA	0.1	52	26 (50.0%)	1 (1.9%)	25 (48.1%)	1	0.09	15	0.03	0.5
BICARBONATE AS CACO3	None	49	1 (2.0%)	48 (98.0%)	N/A	205	102	251	10	10
CARBONATE	None	49	48 (98.0%)	1 (2.0%)	N/A	Nondetect	17	17	1	10
CHEMICAL OXYGEN DEMAND	None	1	0 (0.0%)	1 (100.0%)	N/A	46	46	46	N/A	N/A
CHLORIDE	250	53	1 (1.9%)	52 (98.1%)	0 (0.0%)	56	11.6	83.8	2	2
CYANIDE	0.005	19	18 (94.7%)	0 (0.0%)	1 (5.3%)	Nondetect	0.0163	0.0163	0.001	0.02
DISSOLVED ORGANIC CARBON	None	21	0 (0.0%)	21 (100.0%)	N/A	11	5	12	N/A	N/A
FLUORIDE	2	53	3 (5.7%)	50 (94.3%)	0 (0.0%)	0.7	0.45	0.91	0.5	0.5
HARDNESS, TOTAL	None	46	0 (0.0%)	46 (100.0%)	N/A	197	118	209	N/A	N/A
HEXAVALENT CHROMIUM	11	43	40 (93.0%)	3 (7.0%)	0 (0.0%)	Nondetect	0.02	0.06	0.01	0.02
NITRATE	10	37	21 (56.8%)	16 (43.2%)	0 (0.0%)	0.12	0.03	0.31	0.02	0.1
NITRATE/NITRITE	10	64	47 (73.4%)	17 (26.6%)	0 (0.0%)	0.14	0.02	3.1	0.01	0.1
NITRITE	0.5	41	41 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.25
OIL AND GREASE	None	13	10 (76.9%)	3 (23.1%)	N/A	20	8.1	21	5	8.2
ORTHOPHOSPHATE	None	44	31 (70.5%)	13 (29.5%)	N/A	0.02	0.01	0.13	0.01	0.05
PHOSPHORUS	None	17	1 (5.9%)	16 (94.1%)	N/A	0.17	0.04	0.2	0.01	0.01
SILICA	None	1	0 (0.0%)	1 (100.0%)	N/A	3.6	3.6	3.6	N/A	N/A
SILICON	None	4	4 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	2	2
SULFATE	250	53	2 (3.8%)	51 (96.2%)	0 (0.0%)	57	28	89	10	10
SULFIDE	0.002	15	14 (93.3%)	0 (0.0%)	1 (6.7%)	Nondetect	17	17	1	1
TOTAL ALKALINITY	None	4	1 (25.0%)	3 (75.0%)	N/A	210	176	210	10	10
TOTAL DISSOLVED SOLIDS	None	109	1 (0.9%)	108 (99.1%)	N/A	454	140	522	2	2
TOTAL KJELDAHL NITROGEN	None	2	2 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	1	1
TOTAL ORGANIC CARBON	None	19	0 (0.0%)	19 (100.0%)	N/A	18	7	22	N/A	N/A
TOTAL SUSPENDED SOLIDS	None	108	4 (3.7%)	104 (96.3%)	N/A	32	0	211	2	5
TOTAL VOLATILE SUSPENDED	None	1	0 (0.0%)	1 (100.0%)	N/A	15	15	15	N/A	N/A

TABLE 4-16
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WATER QUALITY PARAMETERS SUMMARY STATISTICS

Location	Analyte	Segment 5 Standard (mg/L)	Sample Size	Nondetected Concentration Number (Pct)	Detects Not Exceeding Standard Number (Pct)	Detects Exceeding Standard Number (Pct)	85th Percentile (mg/L)	Detected Concentration		Nondetected Concentration	
								Minimum (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Maximum (mg/L)
SW098	AMMONIA	None	1	1 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.03	0.03
SW098	BICARBONATE	None	21	0 (0.0%)	21 (100.0%)	N/A	480	213	570	N/A	N/A
SW098	CARBONATE	None	23	11 (47.8%)	12 (52.2%)	N/A	50.1	0	76.5	1	10
SW098	CHLORIDE	250	19	0 (0.0%)	18 (94.7%)	1 (5.3%)	190	140	590	N/A	N/A
SW098	CYANIDE	0.005	19	19 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.0015	0.02
SW098	DISSOLVED ORGANIC CARBON	None	6	0 (0.0%)	6 (100.0%)	N/A	32.35	21.7	32.35	N/A	N/A
SW098	FLUORIDE	2	19	0 (0.0%)	19 (100.0%)	0 (0.0%)	0.82	0.5	0.9	N/A	N/A
SW098	NITRATE	10	2	1 (50.0%)	1 (50.0%)	0 (0.0%)	0.07	0.07	0.07	0.02	0.02
SW098	NITRATE, AS NITROGEN	10	11	9 (81.8%)	2 (18.2%)	0 (0.0%)	0.07	0.07	0.2	0.02	0.1
SW098	NITRATE/NITRITE	10	21	14 (66.7%)	7 (33.3%)	0 (0.0%)	0.1	0.04	0.32	0.02	0.1
SW098	NITRATE/NITRITE, AS NITROGEN	10	4	2 (50.0%)	2 (50.0%)	0 (0.0%)	0.13	0.11	0.13	0.05	0.05
SW098	NITRITE	0.5	16	16 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.05
SW098	NITRITE, AS NITROGEN	0.5	13	13 (100.0%)	0 (0.0%)	0 (0.0%)	Nondetect	N/A	N/A	0.01	0.05
SW098	OIL AND GREASE	None	18	14 (77.8%)	4 (22.2%)	N/A	0.5	0.4	2	1	7.1
SW098	ORTHOPHOSPHATE	None	12	12 (100.0%)	0 (0.0%)	N/A	Nondetect	N/A	N/A	0.01	0.05
SW098	PHOSPHATE	None	7	2 (28.6%)	5 (71.4%)	N/A	0.04	0.02	0.04	0.01	0.05
SW098	PHOSPHORUS	None	12	7 (58.3%)	5 (41.7%)	N/A	0.44	0.03	0.57	0.05	0.05
SW098	SILICA	None	5	0 (0.0%)	5 (100.0%)	N/A	12	2.3	12	N/A	N/A
SW098	SULFATE	250	23	0 (0.0%)	23 (100.0%)	0 (0.0%)	25.8	7	33	N/A	N/A
SW098	SULFIDE	0.002	14	13 (92.9%)	0 (0.0%)	1 (7.1%)	Nondetect	2	2	1	10
SW098	TOTAL DISSOLVED SOLIDS	None	25	0 (0.0%)	25 (100.0%)	N/A	814	230	1070	N/A	N/A
SW098	TOTAL ORGANIC CARBON	None	8	0 (0.0%)	8 (100.0%)	N/A	33.95	21.4	51	N/A	N/A
SW098	TOTAL SUSPENDED SOLIDS	None	25	15 (60.0%)	10 (40.0%)	N/A	12	2	4900	1	5

TABLE 4-17
DRAINAGE PONDS HISTORIC WATER QUALITY PROBLEM OR NPDES EXCEEDANCES

Month/Year	Pond/Drainage	Problem	Cause	Reference
May 1981	A-3	Water flowing into A-3 at 120 mg/L nitrate	Overflow pipe in solar pond intercept system discharging water directly to the drainage	DOE 1992
Jun 1981	A-3	Water in A-3 above the 10 mg/L limit for nitrate	Heavy rainfall (1.3") causing runoff of nitrate contamination	DOE 1992
Jun 1981	A-3	Building 373 cooling tower cleaning waste leaked into drainage	Leakage through a soil dike	DOE 1992
Jul 1981	A-series	Nitrate concentrations up to 21 mg/L identified in drainage water	Solar Pond intercept system was not sufficiently effective	DOE 1992
Oct 1984	McKay Ditch	Runoff from west spray field entered McKay Ditch and bypassed the RFETS NPDES discharge points	Excessive application of liquids to the west spray field	DOE 1992
1985	B-3, B-4, B-5	Chlorine exceeded the limit of 0.1 mg/L in Pond B-5	Faulty valve allowed discharge of excess chorinated WWTP effluent to Pond B-3; this water flowed to B-5	DOE 1986
May 1987	B-3	BOD exceeded limit of 10 mg/L	Beleived to be due to algae growth	DOE 1988
Feb 1988	B-3	BOD ecxceedance	Believed to be due to WWTP efficiency and algae growth	DOE 1992
Mar 1988	B-3	BOD exceedance	Believed to be due to WWTP efficiency and algae growth	DOE 1992
Apr 1988	B-3	BOD exceedance	Believed to be due to WWTP efficiency and algae growth	DOE 1992

Month/Year	Pond/Drainage	Problem	Cause	Reference
Apr 1988	B-3	Fecal coliform exceedances	Unknown	DOE 1989a
May 1988	B-3	BOD exceedance	Believed to be due to WWTP efficiency and algae growth	DOE 1992
Feb 1989	B-3, B-4, B-5	Chromic acid spill	Spill	Whiteman 1989
Apr 1989	SID & C-2	Spill of acid waste	Spill	DOE 1992
Sep 1989	A-4	Leakage from pump into pond	Pump leakage	DOE 1992
Dec 1989	B-3	Fecal coliform 320, limit 200	Unknown	DOE 1992
1989	B-5	Atrazine detections	Use of atrazine as an herbicide	DOE 1992
1989	C-2	Atrazine detections	Use of atrazine as an herbicide	DOE 1992
Apr 1990	B-3	BOD exceeded limit of 10 mg/L	Algae bloom	EG&G 1991
May 1990	B-3	BOD exceeded limit of 10 mg/L	Algae bloom	DOE 1992
Jun 1990	B-3	BOD exceeded limit of 10 mg/L	Algae bloom	DOE 1992
Jul 1990	B-3	Fecal coliform 320, limit 200	Unknown	DOE 1992
Aug 1990	B-3	Fecal coliform 285, limit 200	Possible contaminated sample	DOE 1992
Sep 1990	B-3	BOD exceeded limit of 10 mg/L	Algae bloom	DOE 1992

Table 4-18
Summary of Additional Discharge Data

	Standard (1) Source	Standard Value	Pond A-4 Average	Pond A-4 Maximum	Pond A-4 Standard Deviation	Pond A-4 # of Samples	Pond B-5 Average	Pond B-5 Maximum	Pond B-5 Standard Deviation	Pond B-5 # of Samples	Pond C-2 Average	Pond C-2 Maximum	Pond C-2 Standard Deviation	Pond C-2 # of Samples	Landfill Pond Pre-transfer Samples 3/17/94	Landfill Pond Pre-transfer Samples 6/13/94
Radionuclides (pCi/L)																
Americium-241	WQCC (4)/DCG	0.05/30	0.00	0.02	0.00	34					0.01	0.03	0.01	6	-0.003+/-0.003	-0.001+/-0.005
Cesium-137	NA	NA	-0.04	0.36	0.27	12					0.08	0.14	0.06	3		
Gross Alpha	WQCC (4)	7*/11**	1.82	5.00	0.90	313	1.25	2.00	1.06	2	2.75	4.00	0.77	34	1+/-2	3+/-3
Gross Beta	WQCC (4)	5*/19**	8.77	39.00	2.68	313	11.00	11.00	0.00	2	6.13	8.26	0.74	34	8+/-3	9+/-5
Plutonium-239, 240	WQCC (4)/DCG	0.05/30	0.00	0.05	0.01	27					0.03	0.06	0.02	6	0.001+/-0.003	-0.003+/-0.006
Strontium-89,90	WQCC (SW)	8	0.36	0.93	0.26	10					0.25	0.30	0.05	3		
Strontium-90	WQCC (SW)	8	0.16	0.22	0.08	2										
Tritium	WQCC (4)/DCG	500/1000	44.93	1000.00	123.97	227					86.64	353.00	107.72	27	NA	230+/-219
Uranium-233, 234	WQCC (4)/DCG	5*/10**/500	1.03	2.30	0.41	28					1.25	1.50	0.30	6	1.17+/-0.07	1.11+/-0.13
Uranium-235	WQCC (4)	5*/10**	0.06	0.28	0.06	28					0.04	0.09	0.05	6		
Uranium-238	WQCC (4)	5*/10**	1.05	2.40	0.42	28					1.40	2.10	0.66	6	1.02+/-0.06	0.92+/-0.11
Total Recoverable Metals (µg/L)																
Aluminum	NA	NA	104.59	604.00	160.36	31					166.96	757.00	261.45	9	147B	56B
Antimony	WQCC (SW)	14	17.38	49.30	11.13	31					13.23	19.80	2.90	9	28U	26U
Arsenic	WQCC (4)	50	1.47	3.48	0.78	31					1.02	2.00	0.53	9	1.8B	1.9B
Barium	WQCC (SW)	1000	69.39	93.00	11.82	31					73.97	80.00	3.51	9	175B	129B
Beryllium (3)	WQCC (4)	4	0.77	1.10	0.33	31					0.80	1.00	0.31	9	1U	1U
Cadmium	WQCC (SW)	10	2.32	5.00	1.31	31					3.09	5.20	0.85	9	0.2U	0.1U
Calcium	NA	NA	44009.68	52700.00	4426.16	31					47566.89	49600.00	1722.97	9	43400	28200
Cesium	NA	NA	140.30	250.00	98.59	27					159.56	500.00	151.32	9		
Chromium	WQCC (4)	50	3.57	13.10	2.68	57	4.00	4.00	--	1	3.33	7.00	1.97	12	4U	5U
Cobalt	NA	NA	3.98	20.00	4.49	31					2.60	3.00	0.72	9	4U	5U
Copper	WQCC (SW)	200	6.06	36.60	6.56	31					2.83	4.60	0.96	9	6.2B	3U
Iron	WQCC (4)	1000	99.85	631.00	146.62	31					178.62	656.00	242.73	9	1420	209
Lead	WQCC (SW)	50	1.30	2.70	0.72	31					1.02	1.50	0.25	9	1B	1U
Lithium	NA	NA	12.05	27.10	4.91	27					7.90	10.30	2.36	9		
Magnesium	NA	NA	9489.35	11300.00	988.67	31					14111.11	15700.00	1666.92	9	42700	39700
Manganese	WQCC (4)	1000	31.02	194.00	46.43	31					49.79	162.00	56.75	9	92.4	12B
Mercury	WQCC (4)	0.01	0.130	0.270	0.05	33					0.14	0.42	0.11	9	0.2U	0.1U
Molybdenum	NA	NA	7.97	17.10	3.85	31					5.51	13.60	4.42	9	9U	12U
Nickel	WQCC (SW eg)	200	10.75	33.20	8.01	31					9.00	22.40	5.50	9	10U	15U
Potassium	NA	NA	7920.32	10400.00	1241.19	31					4266.67	4750.00	460.38	9	9370	9090
Selenium	WQCC (4)	10	1.57	4.00	1.09	31					0.81	1.00	0.28	9	1U	1U
Silicon	NA	NA	3399.00	4130.00	306.94	20					2780.00	3470.00	438.95	9		
Silver	WQCC (SW)	50	2.50	5.000	1.60	31					2.47	3.00	0.86	9	0.2U	0.3U
Sodium	NA	NA	36958.06	42500.00	4071.75	31					42633.33	477000.00	6275.15	9	172000	173000
Strontium	NA	NA	260.29	311.00	27.06	31					342.78	369.00	25.01	9	538	446
Thallium	WQCC (SW)	0.012	1.27	4.30	0.83	31					0.92	1.00	0.14	9	1U	0.5U
Titanium	NA	NA													8.9B	4U
Vanadium	NA	NA	4.14	10.00	2.31	31					2.19	3.50	0.56	9	4U	4U
Zinc	WQCC (SW)	2000	22.08	155.00	32.79	31					5.95	15.00	5.11	9	11.1B	14.8B
Water Quality (mg/L)																
Alkalinity (CaCO3)	NA	NA	61.33	125.00	62.10	6					86.50	170.00	94.12	4		
Ammonia	WQCC(4)	0.1	3.21	8.80	2.41	41					0.35	1.30	0.49	6		
Bicarbonate	NA	NA	113.55	140.00	39.05	11					163.67	170.00	7.77	3		
Chloride	WQCC (4)	250	50.82	61.00	7.32	12					40.60	42.00	1.64	3		
Cyanide	WQCC (4)	0.005	0.008	0.020	0.007	2					0.005	0.005	–	1		
Nitrate	WQCC (4)	10	1.94	4.22	0.92	123					0.13	2.19	0.47	21		
Nitrate/Nitrite	WQCC (4)	10	2.26	6.20	1.12	230	2.63	3.06	0.62	2	0.10	0.39	0.12	8	<0.05	NA
Sulfate	WQCC (4)	250	59.91	100.00	16.23	12					41.83	50.00	7.59	3		
Sulfide	WQCC (4)	0.002	5.71	36.00	12.45	8					1.58	7.00	2.65	6		
Total Dissolved Solids	NA	NA	287.89	360.00	58.35	294	336.00	340.00	5.66	2	313.66	410.00	36.36	29		
Total Suspended Solids	NA	NA	14.21	81.00	14.42	350	20.00	21.00	1.41	2	12.59	27.00	5.50	29		
Conductivity	NA	NA													1.28	1.23
Dissolved Oxygen	WQCC (4)	5													8.9	6.2
pH	WQCC (4)	6.5-9.0													7.7	8.6
Total Residual Chlorine	WQCC (4)	0.011													0.005	NA
Organics (µg/L) (2)																
Bis(2-ethylhexyl)phthalate	WQCC (SW)	1.8													13B	0.4BJ
Di-n-butylphthalate	WQCC (SW)	2700													U	0.4BJ
1,2,4-Trichlorobenzene		NA													U	3J
Acenapthene	WQCC (SW)	0.0028 (10 PQL)													U	2J
Butylbenzylphthalate		NA													U	0.7BJ
Diethylphthalate	WQCC (SW)	23000													0.7J	U
Isophorone	WQCC (SW)	1050													U	0.2BJ
Pentachlorophenol	WQCC (SW)	200													U	4J
Pyrene	WQCC (SW)	0.0028 (10 PQL)													U	2J

* Woman Creek - Segment 4 standards; ** Walnut Creek - Segment 4 standards

(1) Standards used to compare mean and maximum values are consistent with the ARARs identified in this document. When available, Segment 4 (WQCC 4) stream standards for Woman and Walnut Creeks were used. When the standards between Woman and Walnut Creek differed, both were provided in this format "Woman/Walnut." DOE derived concentration guides (DCGs) were used as a dual comparison for selected radionuclides with WQCC standards. When no segment-specific standard was available, state-wide (WQCC SW) standards were used. When chronic and acute values were available, chronic (chr) values were chosen. "NA" represents analytes with no applicable WQCC standards. PQL = practical quantification limit.

(2) Organics were tested in the Landfill Pond samples. Volatile organic concentrations were below 1µg/L. The only semi-volatile organics detected are identified on the table. B= compound also detected in the method blank; J=value estimated because it was below method detection limit; U = undetected.

(3) WQCC site-specific standard for dissolved beryllium was used for purposes of comparison because no site-specific standard for total beryllium exists.

10/11/94

TABLE 4-19 (page 1 of 2)
COC Determination for A-Series Ponds

Contaminant Source:				INFLUENT						AMBIENT						DISCHARGE					Pond Water COC
Data Source (Report):				Stormwater NPDES (3)				SWSG (1998) (4)	OU 6 Ph. I RFI/RI (5)	OU 6 Ph. I RFI/RI (6)		RFEDS (7)				Discharge Data (8)		Stormwater (9)			
Sample Location:				GS12 (ICPES)	GS13 (ICPES)	GS13 (GFAA)	GS13 (ICPMS)	N.Walnut Ck	N. Walnut Ck	A-/B-Ponds		Pond A-1	Pond A-2	Pond A-3	Pond A-4	Pond A-4		GS-11 (ICPES)	GS-11 (GFAA)	GS-11 (ICPMS)	
Medium (water or sediment):				water	water	water	water	water	sediment	water	sediment	water	water	water	water	water		water	water	water	
Basis of Comparison:	Standard (1) Source	Standard Value	BUTL (2)	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	COC	COC	COC	85 % > Std	85 % > Std	85 % > Std	85 % > Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	
ANALYTE																					
Radionuclides (total)		pCi/L	pCi/L																		
Americium-241	WQCC (4/8)/DCG	0.05/30		No	No			Yes/No	Yes		Yes	No	No	No	No	No	No	No			
Cesium-137	NA	NA	1.83		No			No						No	No	No	No	No			
Curium-244	NA	NA	NA		No									No	No			No			
Gross Alpha	WQCC (4/8)	7*/11**		No	No			No				No	No	No	No	No	No	No			
Gross Beta	WQCC (4/8)	5*/19**		No	No			No				No	No	No	No	No	Yes	Yes/No			YES
Neptunium-237	NA	NA	NA		NA									NA	NA			NA			
Plutonium-239/240	WQCC (4/8)/DCG	0.05/30		No	Yes			No	Yes		Yes	No	No	No	No	No	No	No			
Radium-226	WQCC (SW)	3***			No																
Radium-228	WQCC (SW)	5***			No																
Strontium-89	NA	NA	NA		No													No			
Strontium-90	WQCC (SW)	8			No			No													
Strontium-89/90	WQCC (SW)	8***												No	No	No	No				
Thorium-232	WQCC (SW)	60***			No													No			
Thorium-230/232	WQCC (SW)	60***												No	No						
Tritium	WQCC (4/8)/DCG	500/1000		No	No			No						No	No	No	Yes/No	No			YES
Uranium (total)	WQCC (4/8)	5*/10**						No								No	No				
Uranium-233	WQCC (4/8)/DCG	(5*/10**)***/500			No											No	No	No			
Uranium-234	WQCC (4/8)/DCG	(5*/10**)***/500			No											No	No				
Uranium-233/234	WQCC (4/8)/DCG	(5*/10**)***/500						No				No	No	No	No	No	No				
Uranium-235	WQCC (4/8)/DCG	(5*/10**)***/600		No	No			No						No	No	No	No	No			
Uranium-238	WQCC (4/8)/DCG	(5*/10**)***/600		No	No			No				No	No	No	No	No	No	No			
Organics (11)		(µg/L)	(µg/L)																		
1,2-Dichloroethene (cis/trans)	WQCC (SW)	(70cis/100trans)								Yes		No	No	No	No						YES
4,4-DDT	WQCC (4/8)/PQL	0.00059/0.1										No	No	No	No						
Acetone	NA	NA								Yes		NA	NA	NA	NA						
Alpha BHC	WQCC (4/8)/PQL	0.0039/0.05										No	Yes								YES
Aroclor-1254	WQCC (4/8)/PQL (PCBs)	4.4E-05/1									Yes	No	No	No	No						
Benzo(a)anthracene	WQCC (4/8)/PQL	0.0028/10							Yes			No	No	No	No						
Benzo(a)pyrene	WQCC (4/8)/PQL	0.0028/10							Yes		Yes	No	No	No	No						
Benzo(b)flouranthene	WQCC (4/8)/PQL	0.0028/10							Yes		Yes	No	No	No	No						
Beta BHC	WQCC (4/8)/PQL	0.014/0.05										Yes	Yes	No	No						YES
Bis(2-ethylhexyl)phthalate	WQCC (SW)/PQL	1.8/10									Yes	No	No	No	Yes						
Carbon tetrachloride	WQCC (SW)/PQL/WQCC (8)	0.25/1.0/18										No	No	No	No						
Chloroform	WQCC (4/8)	6								Yes		No	No	No	No						
Di-n-butylphthalate	WQCC (SW)	2700										No	No	No	No						
Flourene	WQCC (4/8)/PQL	0.0028/10										No	No	No	No						
Indeno(123-cd)pyrene	WQCC (4/8)/PQL	0.0028/10							Yes			No	No	No	No						
Methylene Chloride	WQCC (4/8)	4.7								Yes		No	No	No	No						
Napthalene	WQCC (4/8)/PQL	0.0028/10										No	No	No	No						
Tetrachlorethylene (PCE)	WQCC (4/8)	0.8										No	No	No	No						
Trichloroethene (TCE)	WQCC (SW)/WQCC (8)	2.7/66								Yes		No	No	No	No						YES
Vinyl Chloride	WQCC (SW)	2										No	No	No	No						

(See Footnotes at the end of Table 4-22)

TABLE 4-19 (page 2 of 2)
COC Determination for A-Series Ponds

Contaminant Source: / Data Source (Report): / Sample Location: / Medium (water or sediment): / Basis of Comparison:	Standard (1) Source	Standard Value	BUTL (5)	INFLUENT: Stormwater NPDES (3) GS12 (ICPES) water Mean > Std	Stormwater NPDES (3) GS13 (ICPES) water Mean > Std	GS13 (GFAA) water Mean > Std	GS13 (ICPMS) water Mean > Std	SW60 (1990) (4) N. Walnut Ck water Mean > Std	OU5 Ph. I RFI/RI (6) N. Walnut Ck sediment COC	AMBIENT: OU5 Ph. I RFI/RI (6) A/B-Ponds water COC	OU5 Ph. I RFI/RI (6) A/B-Ponds sediment COC	RFEDS (7) Pond A-1 water 95% > Std	Pond A-2 water 95% > Std	Pond A-3 water 95% > Std	Pond A-4 water 95% > Std	DISCHARGE: Discharge Data (8) Pond A-4 water Mean > Std	Discharge Data (8) Pond A-4 water Max > Std	Stormwater (9) GS-11 (ICPES) water Mean > Std	GS-11 (GFAA) water Mean > Std	GS-11 (ICPMS) water Mean > Std	Pond Water COC
Metals (Total)		µg/L	µg/L																		
Aluminum	NA	NA	3083.75																		
Antimony	WQCC (dw)	14		No	No		No				Yes	No	No	No	No	Yes	Yes	No			
Arsenic	WQCC (ag)	50		No	No	No						No	No	No	No	No	No	No	No		
Barium	WQCC (dw)	1000		No	No							No	No	No	No	No	No	No			
Beryllium	WQCC (ag)	4		No	No							No	No	No	No	No	No	No			
Cadmium	WQCC (dw)	10		No	No							No	No	No	No	No	No	No			
Calcium	NA	NA	48488	No	No							No	No	No	Yes	No	Yes	No			
Cesium	NA	NA	NA	NA	NA		NA					NA	NA	NA	NA	NA	NA	NA		NA	
Chromium	WQCC (ag) Cr-III WQCC (dw) Cr-VI	50/50		No	No							No	No	No	No	No	No	No			
Cobalt	NA	NA	NA	NA	NA				Yes			NA	NA	NA	NA	NA	NA	NA			
Copper	WQCC (dw)/WQCC (f)	200/23		No	No							No	No	No	No	No	No	No			
Iron	WQCC (ag)/WQCC (f)	1000/13200		No	No							No	No	No	No	No	No	No			
Lead	WQCC (dw)/WQCC (f)	50/30		No	Yes	No	Yes					No	No	No	No	No	No	No	No		
Lithium	NA	NA	52	No	No							Yes	Yes	No	No	No	No	No			
Magnesium	NA	NA	6813	No	No							Yes	Yes	Yes	Yes	No	Yes	No			
Manganese	WQCC (ag)	1000		No	No							No	No	No	No	No	No	No			
Mercury	WQCC (dw)	2		No	No	No						No	No	No	No	Yes	Yes	No	No		
Molybdenum	NA	NA	NA	NA	NA							NA	NA	NA	NA	NA	NA	NA			
Nickel	WQCC (dw/ag)	200		No	No							No	No	No	No	No	No	No			
Potassium	NA	NA	4167	No	No							No	Yes	Yes	Yes	Yes	Yes	No			
Selenium	WQCC (ag)	10		No	No	No						No	No	No	No	No	No	No	No		
Silicon	NA	NA	NA	NA	NA							NA	NA	NA	NA	NA	NA	NA			
Silver	WQCC (dw)	50		No	No						Yes	No	No	No	No	No	No	No			
Sodium	NA	NA	33817	No	No							No	No	Yes	Yes	Yes	Yes	No			
Strontium	NA	NA	500	No	No				Yes			No	No	No	No	No	No	No			
Thallium	WQCC (dw)	0.012		No	No	No	Yes					Yes	Yes			Yes	Yes	No		Yes	YES
Tin	NA	NA	67	No	No							No	No	No	No	No	No	No			
Vanadium	NA	NA	20	NA	NA				Yes		Yes	NA	NA	NA	NA	NA	NA	NA			
Zinc	WQCC (dw)/WQCC (f)	2000/350		No	No			No	Yes		Yes	No	No	No	No	No	No	No			
Metals (Dissolved)		µg/L	µg/L													(Not Analyzed)					
Aluminum	WQCC (dw)	87			No									No	No			No			
Antimony	SDWA MCL	6			No		Yes							No	No			No			
Arsenic	WQCC (dw)	150			No	No								No	No			No	No		
Barium	CWA (WQCC-ag)	1000			No									No	No			No			
Beryllium	WQCC (ag)	4			No													No			
Cadmium	WQCC (ag)	1.5			No									No	No			No			
Calcium	NA	NA	50080		No									No	No			No			
Cesium	NA	NA	NA		NA		NA							NA	NA			NA		NA	
Chromium	WQCC (dw) Cr-III/WQCC (ag) Cr-VI	11/11			No									No	No			No			
Cobalt	NA	NA	NA		NA									NA	NA			NA			
Copper	WQCC (ag)	10			No									No	No			No			
Iron	WQCC (ag)	300			No									No	No			No			
Lead	WQCC (ag)	6.48			No	No	No							No	No			No	No	No	
Lithium	NA	NA	64		No									No	No			No			
Magnesium	NA	NA	5800		No									Yes	Yes			No			
Manganese	WQCC (ag)/WQCC (f)	50/300			No									Yes	No			No			
Mercury	WQCC (ag)	0.01				No								No	No				No		
Molybdenum	NA	NA	NA		NA									NA	NA			NA			
Nickel	WQCC (ag)	125			No									No	No			No			
Potassium	NA	NA	3868		No									Yes	Yes			No			
Selenium	WQCC (dw)	17			No	No								No	No			No	No		
Silicon	NA	NA	NA		NA									NA	NA			NA			
Silver	WQCC (ag)	0.59			No									No	No			No			
Sodium	NA	NA	34097		No									No	Yes			No			
Strontium	NA	NA	872		No									No	No			No			
Thallium	WQCC (dw)	15			No	No	No							No	No			No		No	
Tin	NA	NA	63		No									No	No			No			
Vanadium	NA	NA	NA		NA									NA	NA			NA			
Zinc	WQCC (ag)	144			No									No	No			No			
Water Quality Analyte		mg/L	mg/L																		
Alkalinity	CWA (WQCC-AL)	20			Yes										No	No	Yes	Yes			
Ammonia	WQCC (ag)/WQCC (f)	0.1/(1.0/0.7)***										No	No	Yes	Yes	Yes	Yes				YES
Bicarbonate	NA	NA	161		No							Yes	Yes	No	No	No	No	No			
Chloride	WQCC (ag)	250			No							No	No	No	No	No	No	No			
Cyanide	WQCC (ag)	0.005										No	No	No	Yes	Yes	Yes				YES
Dissolved Oxygen (DO)	WQCC (ag)	5																			
Fluoride	WQCC (dw)	2			No							Yes	Yes	No	No			Yes			YES
Nitrate/Nitrite	WQCC (dw)	10						No				No	No	No	No	No	No				
Nitrate	WQCC (ag) (as N)	10			No							No	No	No	No	No	No	No			
Nitrite	WQCC (ag) (as N)	0.5										No	No	No	No						
pH	WQCC (ag)	6.5-9.0																			
Sulfate	WQCC (ag)	250			No							No	No	No	No	No	No	No			
Sulfide	WQCC (ag)	0.002										No	No	No	No	Yes	Yes				YES
Total Dissolved Solids	CWA (WQCC-ag)	230			No							Yes	Yes	Yes	Yes	Yes	Yes	Yes			YES
Total Suspended Solids	NA	NA	125.5		No			No				No	No	No	No	No	No	No			

(See Footnotes at the end of Table 4-22)

TABLE 4-20 (page 1 of 2)
COC Determination for B-Series Ponds

Contaminant Source:				INFLUENT										AMBIENT					DISCHARGE		Pond Water COC
Data Source (Report):				Stormwater NPDES (3)						SWSG (1989) (4)		SWSG (1990) (4)	OU 6 Ph. I RFI/RI (5)	OU 6 Ph. I RFI/RI (6)		RFEDS (7)			Additional Data (8)		
Sample Location:				GS08 (ICPES)	GS08 (GFAA)	GS09 (ICPMS)	GS10 (ICPES)	GS10 (GFAA)	GS10 (ICPMS)	S.Walnut Ck		S.Walnut Ck	N. & S. Walnut Ck	A-/B-Ponds		Pond B-1	Pond B-2	Pond B-5	Pond B-5		
Medium (water or sediment):				water	water	water	water	water	water	water		water	sediment	water	sediment	water	water	water	water		
Criteria:	Standard (1) Source	Standard Value	BUTL (2)	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	COC	COC	COC	95%> Std	95%> Std	95%> Std	Mean> Std	Mean> Std	
ANALYTE																					
Radionuclides		pCi/L	pCi/L																		
Americium-241	WQCC ([illegible]/DCG)	0.05/30		Yes/No			Yes/No			Yes/No	Yes/No	Yes/No	Yes		Yes	Yes/No	No	No			YES
Cesium-137	NA	NA	1.63	No			No					NA						No			
Curium-244	NA	NA	NA	No			No											No			
Gross Alpha	WQCC ([illegible])	7*/11**		No			No			Yes	Yes	No				No	No	No	No	No	
Gross Beta	WQCC ([illegible])	5*/19**		No			No			Yes	Yes	No				No	No	No	No	No	
Neptunium-237	NA	NA	NA	NA			NA											NA			
Plutonium-239/240	WQCC ([illegible]/DCG)	0.05/30		Yes/No			Yes/No			Yes/No	Yes/No	No	Yes		Yes	Yes/No	Yes/No	No			YES
Radium-226	WQCC ([illegible])	5***					No			No	Yes										
Radium-228	WQCC ([illegible])	5***					No														
Strontium-89	NA	NA	NA	No			No														
Strontium-90	WQCC ([illegible])	8					No			No	No	No									
Strontium-89/90	WQCC ([illegible])	8***																No			
Thorium-232	WQCC ([illegible])	60***		No			No														
Thorium-230/232	WQCC ([illegible])	60***																No			
Tritium	WQCC ([illegible]/DCG)	500/1000		No			No			No	No	No						No			
Uranium (total)	WQCC ([illegible])	5*/10**								No	Yes	No									
Uranium-233	WQCC ([illegible]/DCG)	(5*/10**)***/500		No			No														
Uranium-234	WQCC ([illegible]/DCG)	(5*/10**)***/500																			
Uranium-233/234	WQCC ([illegible]/DCG)	(5*/10**)***/500								No	No	No				No	No	No			
Uranium-235	WQCC ([illegible]/DCG)	(5*/10**)***/600		No			No			No	No	No						No			
Uranium-238	WQCC ([illegible]/DCG)	(5*/10**)***/600		No			No			No	No	No				No	No	No			
Organics (11)		(µg/L)	(µg/L)																		
1,2-Dichloroethene	WQCC ([illegible])	(70cis/100trans)												Yes		No	No	No			YES
4,4-DDT	WQCC ([illegible]/PQL)	0.00059/0.1											Yes			No	No	No			
Acetone	NA	NA								NA	NA			Yes		NA	NA	NA			
Alpha BHC	WQCC ([illegible]/PQL)	0.0039/0.05														No	YES	No			YES
Aroclor-1254	WQCC ([illegible]/PQL [illegible])	4.4E-05/1													Yes	No	No	No			
Benzo(a)anthracene	WQCC ([illegible]/PQL)	0.0028/10											Yes			No	No	No			
Benzo(a)pyrene	WQCC ([illegible]/PQL)	0.0028/10											Yes		Yes	No	No	No			
Benzo(b)flouranthene	WQCC ([illegible]/PQL)	0.0028/10											Yes		Yes	No	No	No			
Beta BHC	WQCC ([illegible]/PQL)	0.014/0.05														No	No	No			
Bis(2-ethylhexyl)phthalate	WQCC ([illegible]/PQL)	1.8/10													Yes	No	Yes	No			
Carbon tetrachloride	WQCC ([illegible]/PQL)/WQCC ([illegible])	0.25/1.0/18								Yes	Yes					No	No	No			
Chloroform	WQCC ([illegible])	6								Yes	Yes			Yes		No	No	No			
Di-n-butylphthalate	WQCC ([illegible])	2700														No	No	No			
Fluorene	WQCC ([illegible]/PQL)	0.0028/10														No	No	No			
Indeno(123-cd)pyrene	WQCC ([illegible]/PQL)	0.0028/10											Yes			No	No	No			
Methylene Chloride	WQCC ([illegible])	4.7								No	Yes			Yes		No	No	No			
Napthalene	WQCC ([illegible]/PQL)	0.0028/10														No	Yes	No			YES
Tetrachlorethene (PCE)	WQCC ([illegible])	0.8								No	Yes					No	No	No			
Trichloroethene	WQCC ([illegible]/WQCC ([illegible])	2.7/66								No	Yes			Yes		No	No	No			YES
Vinyl Chloride	WQCC ([illegible])	2								Yes	Yes					No	No	No			

(See Footnotes at the end of Table 4-22)

TABLE 4-20 (page 2 of 2)
COC Determination for B-Series Ponds

Contaminant Source:				INFLUENT										AMBIENT					DISCHARGE		Pond Water COC
Data Source (Report):				Stormwater NPDES (3)						SWWB (1995) (4)		SWWB (1996) (5)	OU 5 Ph. I RFI/RI (6)	OU 5 Ph. I RFI/RI (6)		NPDES (7)			Additional Data (8)		
Sample Location:				GS08 (CPES)	GS08 (OFAA)	GS08 (CPMS)	GS10 (CPES)	GS10 (OFAA)	GS10 (CPMS)	B.Walnut Ck		B.Walnut Ck	N. & B. Walnut Ck	A-/B-Ponds		Pond B-1	Pond B-2	Pond B-5	Pond B-5		
Medium (water or sediment):	Standard (1)	Standard	BUTL (2)	water	water	water	water	water	water	water		water	sediment	water	sediment	water	water	water	water		
Criteria:	Source	Value		Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Mean> Std	Max> Std	Mean> Std	COC	COC	COC	95%> Std	95%> Std	95%> Std	Mean> Std	Max> Std	
Total Metals		µg/L	µg/L																		
Aluminum	NA	NA	3862.79	No			No										No	No			
Antimony	WQCC ([illegible])	14		No		No	No		Yes						Yes		No	No			
Arsenic	WQCC ([illegible])	50		No	No		No	No									No	No			
Barium	WQCC ([illegible])	1000		No			No										No	No			
Beryllium	WQCC ([illegible])	4		No			No										No	No			
Cadmium	WQCC ([illegible])	10		No			No										No	No			
Calcium	NA	NA	46468	No			No										Yes	No			
Cesium	NA	NA	NA	NA		NA	NA		NA								NA	NA			
Chromium	WQCC ([illegible]) Cr+6/ WQCC ([illegible]) Cr+3	50/50		No			No										No	No	No	No	
Cobalt	NA	NA	NA	NA			NA						Yes				NA	NA			
Copper	WQCC ([illegible])/WQCC ([illegible])	200/23		No			Yes			Yes	Yes						No	No			
Iron	WQCC ([illegible])/WQCC ([illegible])	1000/13200		No			No			No	Yes						No	No			
Lead	WQCC ([illegible])/WQCC ([illegible])	50/28		No	No	Yes	Yes	No	Yes	No	Yes						No	No			
Lithium	NA	NA	92	No			No										No	No			
Magnesium	NA	NA	9913	No			No										Yes	No			
Manganese	WQCC ([illegible])	1000		No			No										No	No			
Mercury	WQCC ([illegible])	2		No	No		No	No									No	No			
Molybdenum	NA	NA	NA	NA			NA										NA	NA			
Nickel	WQCC ([illegible])	200		No			No										No	No			
Potassium	NA	NA	4167	No			No										Yes	Yes			
Selenium	WQCC ([illegible])	10		No	No		No	No									No	No			
Silicon	NA	NA	NA	NA			NA										NA	NA			
Silver	WQCC ([illegible])	50		No			No	No							Yes		No	No			
Sodium	NA	NA	33917	No			No										Yes	Yes			
Strontium	NA	NA	390	No			No						Yes				No	No			
Thallium	WQCC ([illegible])	0.012		No	No	Yes	No	No	Yes								No				
Tin	NA	NA	87	No			No										No	No			
Vanadium	NA	NA	29	NA			NA						Yes				NA	NA			
Zinc	WQCC ([illegible])/WQCC ([illegible])	2000/350		No			No			No	No	No	Yes				No	No			
Dissolved Metals		µg/L	µg/L																		
Aluminum	WQCC ([illegible])	87		No			No											No			
Antimony	SDWA MCL	6		No		Yes	No		Yes									No			
Arsenic	WQCC ([illegible])	150		No	No		No	No										No			
Barium	CWA ([illegible])	1000		No			No			No	No							No			
Beryllium	WQCC ([illegible])	4		No			No			No	Yes										
Cadmium	WQCC ([illegible])	1.5		No			No											No			
Calcium	NA	NA	50360	No			No			Yes	Yes							No			
Cesium	NA	NA	NA			NA	NA		NA									NA			
Chromium	WQCC ([illegible])/WQCC ([illegible])	1/11		No			No											No			
Cobalt	NA	NA	NA	NA			NA											No			
Copper	WQCC ([illegible])	16		No			No			No	Yes							No			
Iron	WQCC ([illegible])	300		No			No											No			
Lead	WQCC ([illegible])	6.40		No	No	No	No	No	Yes									No			
Lithium	NA	NA	84	No			No											No			
Magnesium	NA	NA	9808	No			No			Yes	Yes							No			
Manganese	WQCC ([illegible])/WQCC ([illegible])	50/360		No			No			No	Yes							Yes			
Mercury	WQCC ([illegible])	0.01			No		No	No										No			
Molybdenum	NA	NA	NA	NA			NA											NA			
Nickel	WQCC ([illegible])	125		No			No											No			
Potassium	NA	NA	3800	No			No			No	No							No			
Selenium	WQCC ([illegible])	17		No	No		No	No										No			
Silicon	NA	NA	NA	NA			NA											No			
Silver	WQCC ([illegible])	0.30		No			No	No										No			
Sodium	NA	NA	34697	No			No			No	Yes							Yes			
Strontium	NA	NA	972	No			No			No	Yes							No			
Thallium	WQCC ([illegible])	15		No	No	No	No	No	No									No			
Tin	NA	NA	85	No			No											No			
Vanadium	NA	NA	NA	NA			NA											No			
Zinc	WQCC ([illegible])	144		No			No			No	Yes							No			
Water Quality Analyte		mg/L	mg/L																		
Alkalinity	CWA ([illegible])	20		Yes			Yes											No			
Ammonia	WQCC ([illegible])/WQCC ([illegible])	[illegible]														No	No	Yes			YES
Bicarbonate	NA	NA	191	No			No			Yes	Yes					No	Yes	No			
Chloride	WQCC ([illegible])	250		No			No			No	No					No	No	No			
Cyanide	WQCC ([illegible])	0.005		No												No	No	Yes			YES
Dissolved Oxygen (DO)	WQCC ([illegible])	5																			
Fluoride	WQCC ([illegible])	2		No			No									No	No	No			
Nitrate/Nitrite	WQCC ([illegible])	10		No						No	No					No	No	No	No	No	
Nitrate	WQCC ([illegible])	10		No			No			Yes	Yes					No	No	No			
Nitrite	WQCC ([illegible])	0.5		No												No	No	Yes			YES
pH	WQCC ([illegible])	6.5-9.0																			
Sulfate	WQCC ([illegible])	250		No			No			No	No					No	No	No			
Sulfide	WQCC ([illegible])	0.002		No												No	No	No			
Total Dissolved Solids	CWA ([illegible])	250		No			No			Yes	Yes					Yes	Yes	Yes	Yes	Yes	YES
Total Suspended Solids	NA	NA	125.5	No								No				No	No	No	No	No	

(See Footnotes at the end of Table 4-22)

TABLE 4-21 (page 1 of 2)
COC Determination for Pond C-2

Contaminant Source:				INFLUENT					AMBIENT	DISCHARGE		Pond Water COC
Data Source (Report):				Stormwater NPDES (3)	SWSG (1989) (4)		SWSG (1990) (4)	ESEAT (1992) (10)	RFEDS (1994) (7)	Additional Data (8)		
Sample Location:				SW027 (ICPES)	SID		SID	SID	Pond C-2	Pond C-2		
Medium (water or sediment):				water	water		water	sediment	water	water		
Criteria:	Standard (1) Source	Standard Value	BUTL (2)	Mean> Std	Mean> Std	Max> Std	Mean> Std	Detected	85% > Std	Mean> Std	Max> Std	
ANALYTE												
Radionuclides		pCi/L	pCi/L									
Americium-241	WQCC (4/5)/OCG	0.05/30		No	No	Yes/No	No	Yes	No	No	No	
Cesium-137	NA	NA	1.63						No	No	No	
Curium-244	NA	NA	NA						No			
Gross Alpha	WQCC (4/5)	7*/11**		Yes	Yes	Yes	No		No	No	No	
Gross Beta	WQCC (4/5)	5*/19**		No	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Neptunium-237	NA	NA	NA						NA			
Plutonium-239/240	WQCC (4/5)/OCG	0.05/30		No	Yes/No	Yes/No	No	Yes/No	Yes/No	No	Yes	Yes
Radium-226	WQCC (SW)	5***			No	Yes						
Radium-228	WQCC (SW)	5***										
Strontium-89	NA	NA	NA									
Strontium-90	WQCC (SW)	8					No					
Strontium-89/90	WQCC (SW)	8***							No	No	No	
Thorium-232	WQCC (SW)	60***										
Thorium-230/232	WQCC (SW)	60***							No			
Tritium	WQCC (4/5)/OCG	500/1000					No		No	No	No	
Uranium (total)	WQCC (4/5)	5*/10**			Yes	Yes						
Uranium-233	WQCC (4/5)/OCG	(5*/10**)***/500		No						No	No	
Uranium-234	WQCC (4/5)/OCG	(5*/10**)***/500								No	No	
Uranium-233/234	WQCC (4/5)/OCG	(5*/10**)***/500			No	Yes	No		No	No	No	
Uranium-235	WQCC (4/5)/OCG	(5*/10**)***/600		No	No	No	No	Yes	No	No	No	
Uranium-238	WQCC (4/5)/OCG	(5*/10**)***/600		No	No	Yes	No	Yes	No	No	No	
Organics (11)		(µg/L)	(µg/L)									
1,2-Dichloroethene	WQCC (SW)	(70cis/100trans)							No			
4,4-DDT	WQCC (4/5)/PQL	0.00059/0.1							No			
Acetone	NA	NA							NA			
Alpha BHC	WQCC (4/5)/PQL	0.0039/0.05							No			
Aroclor-1254	WQCC (4/5)/PQL (PCBs)	4.4E-05/1							No			
Benzo(a)anthracene	WQCC (4/5)/PQL	0.0028/10							No			
Benzo(a)pyrene	WQCC (4/5)/PQL	0.0028/10							No			
Benzo(b)flouranthene	WQCC (4/5)/PQL	0.0028/10							No			
Beta BHC	WQCC (4/5)/PQL	0.014/0.05							No			
Bis(2-ethylhexyl)phthalate	WQCC (SW)/PQL	1.8/10			Yes	Yes			Yes			
Carbon tetrachloride	WQCC (SW)/PQL/WQCC (5)	0.25/1.0/18							No			
Chloroform	WQCC (4/5)	6			No	Yes			No			
Di-n-butylphthalate	WQCC (SW)	2700							No			
Flourene	WQCC (4/5)/PQL	0.0028/10							No			
Indeno(123-cd)pyrene	WQCC (4/5)/PQL	0.0028/10							No			
Methylene Chloride	WQCC (4/5)	4.7			No	Yes			No			
Napthalene	WQCC (4/5)/PQL	0.0028/10							No			
Tetrachlorethene (PCE)	WQCC (4/5)	0.8							No			
Trichloroethene	WQCC (SW)/WQCC (5)	2.7/66			No	No			No			
Vinyl Chloride	WQCC (SW)	2							No			

(See Footnotes at the end of Table 4-22)

TABLE 4-21 (page 2 of 2)
COC Determination for Pond C-2

Contaminant Source:				INFLUENT					AMBIENT	DISCHARGE		Pond Water COC
Data Source (Report):				Stormwater NPDES (3)	SWSG (1989) (4)		SWSG (1990) (4)	ESEAT (1992) (10)	RFEDS (1994) (7)	Additional Data (8)		
Sample Location:				SW027 (ICPES)	SID		SID	SID	Pond C-2	Pond C-2		
Medium (water or sediment):	Standard (1)	Standard	BUTL (2)	water	water		water	sediment	water	water		
Criteria:	Source	Value		Mean> Std	Mean> Std	Max> Std	Mean> Std	Detected	95% > Std	Mean> Std	Max> Std	
Total Metals		µg/L	µg/L									
Aluminum	NA	NA	3882.76	No					No	No	No	
Antimony	WQCC (SW)	14		No					No	No	Yes	
Arsenic	WQCC (4/5)	50		No					No	No	No	
Barium	WQCC (SW)	1000		No					No	No	No	
Beryllium	WQCC (4/5)	4		No					No	No	No	
Cadmium	WQCC (SW)	10		No					No	No	No	
Calcium	NA	NA	49465						No	No	Yes	
Cesium	NA	NA	NA						NA	NA	NA	
Chromium	WQCC (4/5) Cr-III/ WQCC (SW) Cr-VI	50/50		No					No	No	No	
Cobalt	NA	NA	NA	NA					NA	NA	NA	
Copper	WQCC (SW)/WQCC (5)	200/23		No					No	No	No	
Iron	WQCC (4)/WQCC (5)	1000/13200		No	No	Yes			No	No	No	
Lead	WQCC (SW)/WQCC (5)	50/28		No	No	Yes			No	No	No	
Lithium	NA	NA	52	No					No	No	No	
Magnesium	NA	NA	8813						Yes	Yes	Yes	
Manganese	WQCC (4/5)	1000		No					No	No	No	
Mercury	WQCC (SW)	2							No	Yes	Yes	
Molybdenum	NA	NA	NA	NA					NA	NA	NA	
Nickel	WQCC (SW sg)	200		No					No	No	No	
Potassium	NA	NA	4167	No					Yes	Yes	Yes	
Selenium	WQCC (4/5)	10		No					No	No	No	
Silicon	NA	NA	NA						NA	NA	NA	
Silver	WQCC (SW)	50		No					No	No	No	
Sodium	NA	NA	33817						Yes	Yes	Yes	
Strontium	NA	NA	580	No					No	No	No	
Thallium	WQCC (SW)	0.012		No						Yes	Yes	Yes
Tin	NA	NA	87	No					No			
Vanadium	NA	NA	29	NA					NA	NA	NA	
Zinc	WQCC (SW)/WQCC (5)	2000/350		No	No	Yes	No		No	No	No	
Metals(Dissolved)		µg/L	µg/L									
Aluminum	WQCC (SW)	87		No					No			
Antimony	SDWA MCL	6		No					Yes			
Arsenic	WQCC (SW)	150		No					No			
Barium	CWA (AWQC-HH)	1000		No	No	No			No			
Beryllium	WQCC (4/5)	4		No								
Cadmium	WQCC (4/5)	1.5		No					No			
Calcium	NA	NA	50358	No	Yes	Yes			Yes			
Cesium	NA	NA	NA						NA			
Chromium	WQCC (SW TVS)Cr-III/WQCC (4/5) Cr-VI	1/11		No					No			
Cobalt	NA	NA	NA	NA					No			
Copper	WQCC (4/5)	16		No	No	Yes			No			
Iron	WQCC (4/5)	300		No	No	Yes			No			
Lead	WQCC (4/5)	6.46		No	No	Yes			No			
Lithium	NA	NA	64	No	No	Yes			No			
Magnesium	NA	NA	9600		Yes	Yes			Yes			
Manganese	WQCC (4)/WQCC (5)	50/560		No	No	Yes			Yes			
Mercury	WQCC (4/5)	0.01							No			
Molybdenum	NA	NA	NA	NA					NA			
Nickel	WQCC (4/5)	125		No					No			
Potassium	NA	NA	3586	No	No	Yes			Yes			
Selenium	WQCC (SW)	17		No	No	No			No			
Silicon	NA	NA	NA						NA			
Silver	WQCC (4/5)	0.59		No					No			
Sodium	NA	NA	34097		Yes	Yes			Yes			
Strontium	NA	NA	972		No	Yes			No			
Thallium	WQCC (SW)	15		No					No			
Tin	NA	NA	83	No					No			
Vanadium	NA	NA	NA	No					NA			
Zinc	WQCC (4/5)	144		No	No	Yes			No			
Water Quality Analyte		mg/L	mg/L									
Alkalinity	CWA (AWQC-AL)	20		No					No	Yes	Yes	YES
Ammonia	WQCC(4)/WQCC (5)	0.1/(1.8/0.7)****							Yes	Yes	Yes	Yes
Bicarbonate	NA	NA	191						Yes	No	No	
Chloride	WQCC (4/5)	250		No	No	No			No	No	No	
Cyanide	WQCC (4/5)	0.005							No	No	No	
Dissolved Oxygen (DO)	WQCC (4/5)	5										
Fluoride	WQCC (SW)	2		No					No	No	No	
Nitrate/Nitrite	WQCC (SW)	10			No	No	No		No	No	No	
Nitrate	WQCC (4/5) (as N)	10			No	Yes			No			
Nitrite	WQCC (4/5) (as N)	0.5							No	No	No	
pH	WQCC (4/5)	6.5-9.0										
Sulfate	WQCC (4/5)	250		No	No	No			No	No	No	
Sulfide	WQCC (4/5)	0.002							No	Yes	Yes	Yes
Total Dissolved Solids	CWA (AWQC-HH)	250		Yes	Yes	Yes			Yes	Yes	Yes	Yes
Total Suspended Solids	NA	NA	125.5	No			No		No	No	No	

(See Footnotes at the end of Table 4-22)

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TABLE 4-22 (page 1 of 2)
COC Determination for the Landfill Pond (SW098)

Contaminant Source:				INFLUENT			AMBIENT	Discharge		Pond
Data Source (Report):				SWSG (1989) (4)		SWSG (1990) (4)	RFEDS (1994) (7)	Predischarge Samples		Water
Sample Location:				Landfill Area		Landfill Area	SW098	3/17/94	6/13/94	COC
Medium (water or sediment):				water	water	water	water	water	water	(none
Criteria:	Standard (1)	Standard	BUTL (2)	Mean> Std	Max> Std	Mean> Std	85% > Std	Sample>Std	Sample>Std	identified)
	Source	Value								
ANALYTE										
Radionuclides		pCi/L	pCi/L							
Americium-241	WQCC (4/5)/DCG	0.05/30		No	Yes/No	No	No	No	No	
Cesium-137	NA	NA	1.63							
Curium-244	NA	NA	NA							
Gross Alpha	WQCC (4/5)	7*/11**		Yes	Yes	No	No	No	No	
Gross Beta	WQCC (4/5)	5*/19**		Yes	Yes	No	No	No	No	
Neptunium-237	NA	NA	NA							
Plutonium-239/240	WQCC (4/5)/DCG	0.05/30				No	No	No	No	
Radium-226	WQCC (SW)	5***		No	Yes					
Radium-228	WQCC (SW)	5***								
Strontium-89	NA	NA	NA							
Strontium-90	WQCC (SW)	8		No	No	No				
Strontium-89/90	WQCC (SW)	8***								
Thorium-232	WQCC (SW)	60***								
Thorium-230/232	WQCC (SW)	60***								
Tritium	WQCC (4/5)/DCG	500/1000				No			No	
Uranium (total)	WQCC (4/5)	5*/10**		No	Yes					
Uranium-233	WQCC (4/5)/DCG	(5*/10**)***/500								
Uranium-234	WQCC (4/5)/DCG	(5*/10**)***/500								
Uranium-233/234	WQCC (4/5)/DCG	(5*/10**)***/500		No	Yes	No	No	No	No	
Uranium-235	WQCC (4/5)/DCG	(5*/10**)***/600				No		No	No	
Uranium-238	WQCC (4/5)/DCG	(5*/10**)***/600		No	Yes	No	No			
Organics (11)		(µg/L)	(µg/L)							
1,2-Dichloroethene	WQCC (SW)	(70cis/100trans)		Yes	Yes		No			
4,4-DDT	WQCC (4/5)/PQL	0.00059/0.1					No			
Acetone	NA	NA					No			
Alpha BHC	WQCC (4/5)/PQL	0.0039/0.05					No			
Aroclor-1254	WQCC (4/5)/PQL (PCBs)	4.4E-05/1					No			
Benzo(a)anthracene	WQCC (4/5)/PQL	0.0028/10					No			
Benzo(a)pyrene	WQCC (4/5)/PQL	0.0028/10					No			
Benzo(b)flouranthene	WQCC (4/5)/PQL	0.0028/10					No			
Beta BHC	WQCC (4/5)/PQL	0.014/0.05					No			
Bis(2-ethylhexyl)phthalate	WQCC (SW)/PQL	1.8/10					No	No	No	
Carbon tetrachloride	WQCC (SW)/PQL/WQCC (5)	0.25/1.0/18					No			
Chloroform	WQCC (4/5)	6					No			
Di-n-butylphthalate	WQCC (SW)	2700					No	No	No	
Flourene	WQCC (4/5)/PQL	0.0028/10					No			
Indeno(123-cd)pyrene	WQCC (4/5)/PQL	0.0028/10					No			
Methylene Chloride	WQCC (4/5)	4.7		Yes	Yes		No			
Napthalene	WQCC (4/5)/PQL	0.0028/10					No			
Tetrachlorethene (PCE)	WQCC (4/5)	0.8					No			
Trichloroethene	WQCC (SW)/WQCC (5)	2.7/66		No	Yes		No			
Vinyl Chloride	WQCC (SW)	2					No			

(See Footnotes at the end of Table 4-22)

TABLE 4-22 (page 2 of 2)
COC Determination for the Landfill Pond (SW098)

Contaminant Source:				INFLUENT			AMBIENT	Discharge		Pond
Data Source (Report):				SWSG (1989) (4)		SWSG (1990) (4)	RFEDS (1994) (7)	Predischarge Samples		Water
Sample Location:				Landfill Area		Landfill Area	SW098	3/17/94	6/13/94	COC
Medium (water or sediment):				water	water	water	water	water	water	
Criteria:	Standard (1)	Standard	BUTL (2)	Mean> Std	Max> Std	Mean> Std	95% > Std	Sample>Std	Sample>Std	
Total Metals	Source	Value						No	No	
Aluminum	NA	NA	3892.76				No	No	No	
Antimony	WQCC (SW)	14					No	No	No	
Arsenic	WQCC (4/5)	50					No	No	No	
Barium	WQCC (SW)	1000					No	No	No	
Beryllium	WQCC (4/5)	4					No	No	No	
Cadmium	WQCC (SW)	10					No	No	No	
Calcium	NA	NA	49465				No	No	No	
Cesium	NA	NA	NA				No			
Chromium	WQCC (4/5) Cr-III/ WQCC (SW) Cr-VI	50/50					No	No	No	
Cobalt	NA	NA	NA				No	No	No	
Copper	WQCC (SW)/WQCC (5)	200/23					No	No	No	
Iron	WQCC (4)/WQCC (5)	1000/13200		Yes	Yes		No	No	No	
Lead	WQCC (SW)/WQCC (5)	50/28		No	No		No	No	No	
Lithium	NA	NA	52				No			
Magnesium	NA	NA	9613				No	No	No	
Manganese	WQCC (4/5)	1000					No	No	No	
Mercury	WQCC (SW)	2					No	No	No	
Molybdenum	NA	NA	NA				No	No	No	
Nickel	WQCC (SW ag)	200					No	No	No	
Potassium	NA	NA	4167				No	No	No	
Selenium	WQCC (4/5)	10					No	No	No	
Silicon	NA	NA	NA				No			
Silver	WQCC (SW)	50					No	No	No	
Sodium	NA	NA	33617				No	No	No	
Strontium	NA	NA	590				No	No	No	
Thallium	WQCC (SW)	0.012					No	No	No	
Tin	NA	NA	67				No	No	No	
Vanadium	NA	NA	29				No	No	No	
Zinc	WQCC (SW)/WQCC (5)	2000/350		Yes	Yes	No	No	No	No	
Metals(Dissolved)		µg/L	µg/L							
Aluminum	WQCC (SW)	87		No	Yes					
Antimony	SDWA MCL	6								
Arsenic	WQCC (SW)	150								
Barium	CWA (AWQC-HH)	1000		No	No					
Beryllium	WQCC (4/5)	4		No	Yes					
Cadmium	WQCC (4/5)	1.5								
Calcium	NA	NA	50356	No	No					
Cesium	NA	NA	NA							
Chromium	WQCC (SW TVS)Cr-III/WQCC (4/5) Cr-VI	1/11								
Cobalt	NA	NA	NA							
Copper	WQCC (4/5)	16		Yes	Yes					
Iron	WQCC (4/5)	300		Yes	Yes					
Lead	WQCC (4/5)	*8.46*								
Lithium	NA	NA	84	No	No					
Magnesium	NA	NA	9600	Yes	Yes					
Manganese	WQCC (4)/WQCC (5)	50/580		Yes	Yes					
Mercury	WQCC (4/5)	0.01								
Molybdenum	NA	NA	NA							
Nickel	WQCC (4/5)	125								
Potassium	NA	NA	3586	Yes	Yes					
Selenium	WQCC (SW)	17		Yes	Yes					
Silicon	NA	NA	NA							
Silver	WQCC (4/5)	0.59								
Sodium	NA	NA	34097	Yes	Yes					
Strontium	NA	NA	972	No	Yes					
Thallium	WQCC (SW)	15								
Tin	NA	NA	83							
Vanadium	NA	NA	NA							
Zinc	WQCC (4/5)	144		Yes	Yes					
Water Quality Analyte		mg/L	mg/L							
Alkalinity	CWA (AWQC-AL)	20								
Ammonia	WQCC(4)/WQCC (5)	0.1/(1.8/0.7)****					No			
Bicarbonate	NA	NA	191	Yes	Yes		No			
Chloride	WQCC (4/5)	250		*No*	Yes		No			
Cyanide	WQCC (4/5)	0.005					No			
Dissolved Oxygen (DO)	WQCC (4/5)	5		No	Yes		No	No	No	
Flouride	WQCC (SW)	2					No			
Nitrate/Nitrite	WQCC (SW)	10		No	Yes		No	No		
Nitrate	WQCC (4/5) (as N)	10		No	Yes		No			
Nitrite	WQCC (4/5) (as N)	0.5					No			
pH	WQCC (4/5)	6.5-9.0		No	No		No	No	No	
Sulfate	WQCC (4/5)	250		No	Yes		No			
Sulfide	WQCC (4/5)	0.002					No			
Total Dissolved Solids	CWA (AWQC-HH)	250		Yes	Yes		Yes			YES
Total Suspended Solids	NA	NA	125.5	No	No	No	No			

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(See Footnotes at the end of Table 4-22)

TABLE 4-23
Summary of COCS For Monitoring Pond Water Quality

COCs Identified in Ponds Based on Exceedances of Standards

Analyte	A-series	B-series	C-2	Landfill
Radionuclides				
Americium-241		X***		
Gross Beta	X		X	
Plutonium-239/240		X***	X	
Tritium	X			
Organics				
1,2-Dichloroethene (cis/trans)	X*	X*		
Alpha BHC	X	X***		
Beta BHC	X			
Napthalene		X***		
Trichloroethene	X*	X*		
Total Metals				
Thallium	X***		X	
WATER QUALITY				
Alkalinity			X**	
Ammonia	X	X	X	
Cyanide	X	X		
Fluoride	X			
Nitrite		X		
Sulfide	X		X	
Total Dissolved Solids	X**	X**	X**	X**

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Additional Water Quality Indicators Recommended for Monitoring

Gross Alpha
Hardness
Specific Conductance
Temperature
Total Suspended Solids
pH
Turbidity

*These COCs were selected based on their status as COCs for OU 6. RFEDS pond data did not identify them as COCs. Organic COCs which were selected for OU 6 but are not reflected in this COC list include acetone, chloroform, methylene chloride and bis(2-ethylhexyl)phthalate. These were not detected in RFEDS data with the exception of bis(2-ethylhexyl)phthalate and are expected to be laboratory contaminants or sampling artifacts.

**These COCs do not have WQCC stream standards and were selected based on either SDWA or CWA standards.

***These COCs were selected based on contaminants in the interior ponds (A-1, A-2, B-1, or B-2) only.

TABLE NOTES:

(1): Standards used to compare mean, maximum and 85th percentile values are consistent with the ARARs identified in this document. When available, Segment 4 and 5 (WQCC 4/5) stream standards for Woman and Walnut Creeks were used. When the standards between Woman and Walnut Creek differed, both were provided in this format: "Woman/Walnut." DOE derived concentration guides (DCGs) were used as a dual comparison for selected radionuclides with WQCC standards. Temporary modifications for Segment 5 (WQCC 5) were used where appropriate. When no segment-specific standard was available, state-wide (WQCC SW) standards were used. If these standards were not available, Safe Drinking Water Act Maximum Contaminant Limits (SDWA MCLs) or Clean Water Act agricultural (CWA ag) standards were used for some dissolved metals. When chronic and acute values were available, chronic (chr) values were chosen. Similarly, if multiple WQCC standards were available, the most stringent was selected. "NA" represents analytes with no applicable standards. The WQCC site-specific standard for dissolved beryllium was used for purposes of comparison for total beryllium because no site-specific standard for total beryllium exists.

(2): BUTLs refer to background upper tolerance limits as identified in the 1993 Background Geochemical Characterization Report. These values are provided for those analytes with no ARARs. They represent the value for which 99 percent of background samples values will fall below, 99 percent of the time.

(3): Stormwater data is summarized for gaging stations (GS) used in the NPDES Stormwater Permit Application (1993). Three sets of data were available which were tested with three different test methods: (1) inductively coupled plasma emissions spectrometry (ICPES); (2) graphite furnace atomic adsorption (GFAA); and (3) inductively coupled plasma mass spectrometry (ICPMS). The latter two were conducted only on selected metals and have detection limits approximately one order of magnitude lower than the ICPES method. For the stormwater data, the mean is compared to the standard (std).

(4): SWSG refers to the Surface Water and Sediment Geochemical Characterization Reports for 1989 and 1990. It should be noted that the radionuclide data for the 1989 report was rejected by data validators. For these data, mean and maximum concentrations were compared to the standards.

(5): For the OU 6 Phase I RFI/RI, a variety of analytes were identified as COCs for North Walnut Creek sediments in Draft Technical Memorandum No. 4 (EG&G, 1994). These analytes are contained in this table because the potential resuspension and subsequent deposition of contaminated stream sediments in the ponds may affect pond water quality.

(6): For the OU 6 Phase I RFI/RI, a variety of analytes were identified as COCs for the A- and B-series pond waters and sediments in Draft Technical Memorandum No. 4 (EG&G, 1994). These analytes are identified in this column. Sediment data is provided because of the potential of resuspension of contaminated sediments in the ponds.

(7): RFEDS refers to Rocky Flats Environmental Database System pond water quality data for 1990 through March 1994. The 85th percentile is compared to the relevant standard. This set of data is the most comprehensive available for the ponds; therefore, emphasis was placed on these data for determination of COCs.

(8): Discharge data is based on discharge data collected for the terminal ponds from January 1991 through June 1994. This data set was also emphasized in COC determination.

(9): Stormwater data available downstream of the Pond A-4 discharge was evaluated because it could show contamination resulting from the ponds. See table note (3) for more detail on these data.

(10): ESEAT refers to the Estimated Soil Erosion and Actinide Transport for the South Interceptor Ditch (EG&G, 1992) report which identified the SID as a source of contaminated sediments in Pond C-2.

(11): Because of the large number of organic compounds tested, this list is a subset of compounds whose 85th percentile value exceeded detection limits for at least one pond or were identified as COCs for OU 6. For a complete listing of organic compounds included in the RFEDs data, see Tables 4-12 through 4-16.

CHAPTER 5

GUIDELINES FOR THE DEVELOPMENT OF POND WATER MANAGEMENT STRATEGIES

5.1 INTRODUCTION AND OVERVIEW

Previous chapters of this report have described the regulatory, physical, administrative, and environmental framework within which surface water management presently occurs at the Rocky Flats Environmental Technology Site (the Site). This chapter serves as a transition point within this document intended to define interim requirements for the implementation of pond water management alternatives while final improvements and remediation activities at other areas of the Site are implemented.

5.2 IDENTIFICATION AND ANALYSIS OF POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section identifies standards that are potentially applicable or relevant and appropriate requirements (ARARs) for pond water management at the Site. The potential ARARs identified in this chapter are intended to establish goals for pond water management, and will replace the National Pollutant Discharge Elimination System (NPDES) requirements that have governed pond discharges from the Site since 1974. These requirements will establish limits and guidelines for management operations, such as transfers of water between ponds, off-site discharges to Segment 4, and volume reduction methods, including spray evaporation or recycling.

It is important to note that the potential ARARs identified in this chapter are specific to the management of pond water under this Interim Measures/Interim Remedial Action (IM/IRA) document. They do not establish requirements that are necessarily appropriate for remediation of other Operable Units (OUs) at the Site. In addition, several efforts are currently underway which may affect the selection of appropriate discharge limits for the ponds. These efforts are discussions between the U.S. Department of Energy (DOE), the Colorado Department of Public Health and Environment (CDPHE), and the U.S. Environmental Protection Agency (EPA) on potential sitewide ARARs and the development of an operations plan for the Woman Creek Reservoir. It will be appropriate to revisit the potential ARARs selected in this document at the time that these issues are resolved.

5.2.1 ARARs - Definition and Purpose

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Reauthorization Act (SARA), requires that remedial actions comply with applicable or relevant and appropriate promulgated numeric standards, performance criteria, or other substantive requirements under other federal and state environmental laws. State requirements can be considered ARARs when they are promulgated and are more stringent than corresponding federal requirements. In instances where no promulgated standards are identified, CERCLA directs parties to look at accepted guidelines and criteria, which are referred to as To Be Considered criteria (TBCs) (EPA 1988). The intent of this requirement is to recognize that while CERCLA does not mandate specific clean-up criteria, other environmental laws and guidelines are useful in determining the framework, standards, and actions which are protective of human health and the environment.

While final actions under CERCLA must comply with ARARs, some latitude is provided for interim actions under both CERCLA and the Interagency Agreement (IAG). ARARs may be waived for an interim action that is part of a total remedial action which will eventually attain ARARs when completed. In the IAG, DOE has committed to attain ARARs "to the greatest extent practicable for IM/IRAs." Thus, the potential ARARs identified in this chapter are goals and guidelines for the management of pond water and discharges at the Site.

5.2.2 Potential Pond Water ARARs and TBCs

The following sections discuss standards and requirements that may be potential ARARs for pond water management. While not a comprehensive list of all federal and state environmental laws and requirements, the following requirements are pertinent to surface water management at the Site for the following reasons:

- They establish numeric limits for contaminants of concern (COCs) identified in Chapter 4 of this document;
- They set forth operational requirements that relate to surface water and/or detention basins; or
- They place limitations on actions in drainages or surrounding wetlands.

5.2.2.1 Safe Drinking Water Act Maximum Contaminant Levels and Maximum Contaminant Level Goals

Maximum Contaminant Levels (MCLs) are promulgated under the Safe Drinking Water Act (SDWA), and represent the maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet of a public water system. They are enforceable standards that must be met at the tap of a publicly supplied water source (40 Code of Federal Regulations [CFR] 141). Maximum Contaminant Level Goals (MCLGs) are unenforceable guidelines established at levels for which no known or anticipated adverse effects on human health will occur and are often used by the EPA as the basis for promulgating MCLs. Neither MCLs or MCLGs are applicable to surface water discharges from the ponds because the stream segments are not public water supplies. MCLs and non-zero MCLGs may be relevant and appropriate to Segment 4 and Segment 5 because they are currently classified by the state as water supply.

It is important to note, however, that surface water from the Site is currently diverted around two adjacent existing drinking water supplies; therefore, the water supply classification may change in the future. In addition prior to delivery as a drinking water supply, surface water would be treated. Nevertheless, MCLs and non-zero MCLGs may be relevant and appropriate to actions involving discharges to Segments 4 and 5 while the water supply classification remains.

5.2.2.2 Ambient Water Quality Criteria

Ambient Water Quality Criteria (AWQC), developed under the Clean Water Act (CWA), like MCLGs, are guidelines for water management. States use AWQC to establish water quality standards for surface water to protect aquatic life and human health, based on consumption of drinking water and fish. The AWQC are by definition guidelines, but may be considered relevant and appropriate to pond water management because Segments 4 and 5 are classified as potential sources of drinking water and for aquatic life.

5.2.2.3 Colorado Statewide (Basic) and Site-Specific Surface Water Standards

Under Section 3.8.0 of 5 Colorado Code of Regulations (CCR) 1002-8, water quality standards have been adopted by the Colorado Water Quality Control Commission (WQCC) for Segments 4 and 5. Standards for metals, inorganics, and organics are designed to protect the state-designated uses for Segments 4 and 5 and are equivalent to or more stringent than federal AWQC and MCLs. Radionuclide standards for gross alpha, gross beta, plutonium, americium, tritium, and uranium are not health-based but are based on existing ambient quality in each segment. The ambient levels were deemed to be protective of the designated uses because they are "below (more stringent than) current drinking water standards or other available health-based criteria for these radionuclides" (CDPHE 1994, Section 3.8.30(3)). For organics, the WQCC specifically adopted detection limits based on practical quantitation limits (PQLs) as the compliance threshold in recognition of the technical limitations on chemical measurements. The PQLs for organics are based on gas chromatography/mass spectroscopy, with certain exceptions.

The WQCC also established basic or statewide standards for surface water. These standards are specific to a designated stream classification and are used statewide in instances where no site-specific standards have been assigned (CDPHE 1993).

The WQCC site-specific and statewide stream standards are set as in-stream or ambient values that relate to and protect the designated uses, and are used by the state and EPA as the basis for setting water quality effluent limitations for point source discharges under the NPDES permit system. Essentially the permit is the mechanism by which stream standards are enforced. Depending on site-specific conditions, the effluent limit may or may not be equivalent to the stream standard.

Under the current NPDES permit, pond water discharges to Segments 4 and 5 are regulated as point source discharges subject to certain limitations. It would be consistent with the intended use of the state stream standards to designate non-radionuclide standards as potential ARARs for establishing appropriate discharge limitations for routine pond discharges. (The radionuclide standards are not considered potential ARARs for the reasons discussed below. However, they will be used as a basis of assessing water quality discharges from the ponds.) The site-specific standards for Segments 4 and 5 would take precedence in establishing the potential ARAR for a particular constituent; however, the statewide standards may be pertinent to compounds for which no site-specific standards have been established.

5.2.2.4 DOE Order 5400.5

The Atomic Energy Act, as amended (42 U.S.C. Section 2021(c)), provides for federal control over radionuclide discharges from DOE facilities. Through DOE Order 5400.5, "Radiation Protection for the Public and the Environment," DOE established public dose limits (PDLs) for all sources of radiation at DOE facilities (DOE 1990). DOE's comprehensive PDL for total exposure via all pathways is 100 mrem/year. (A "rem" is equal to the absorbed dose in radiation multiplied by a quality factor to express the relative biological effectiveness of the radiation [EG&G 1989]). The 100 mrem per year was established based on recommendations of the International Commission on Radiological Protection and the National Council on Radiation Protection.

DOE has developed isotope-specific derived concentration guides (DCGs) that represent the smallest estimated concentrations in water or air that will result in a 50-year effective dose equivalent to 100 mrem from one year's chronic exposure. For the water ingestion pathway, DOE assumed an ingestion rate of 2 liters per day continuously for one year. The Agreement in Principal (AIP) recognizes DCGs as the values which govern monitoring activities and analyses for the Site. Although not formally promulgated standards, DCGs are appropriate health-based standards for assessing radionuclide concentrations in the ponds and are TBCs.

5.2.2.5 Wetlands Protection Requirements

The principal federal laws regulating activities in wetlands are Sections 404 and 401 of the CWA, Section 10 of the Rivers and Harbors Act, and the National Environmental Policy Act (NEPA) under 10 CFR 1022.

Section 404 of the federal CWA requires a permit for the placement of dredge or fill materials into "waters of the United States." This includes all jurisdictional wetlands, as defined by the U.S. Army Corps of Engineers' (USACE) *Wetland Delineation Report, Final Technical Report, T-87-1* (USACE 1987). A 1992 mapping of wetlands indicates that portions of the North Walnut and Woman Creek drainages, the South Interceptor Ditch (SID), and the ponds have associated wetlands that may be classified as jurisdictional wetlands (Figure 5-1). In August 1994, the USACE completed a formal wetlands delineation of the Site (USACE 1994). This report and associated mapping will be used to assess potential wetland impacts from pond operations.

When work is proposed to occur within a wetland, the nature of the impact and the type of wetland determine the type of permit that may apply. The Nationwide Permit Program Regulations (33 CFR Part 330) outline 40 nationwide permits that authorize specifically described work. Generally, nationwide permits, such as Nationwide 26, apply to isolated wetlands and wetlands above the headwaters with less than 5 cfs average annual flow. Under a Nationwide 26, up to one acre of wetland impact can occur without mitigation compensation. As another example, Nationwide 5 allows for the placement of scientific measurement devices within wetlands or "waters of the U.S." without mitigation requirements. Generally, the nationwide permits allow for minimal wetland impacts with limited compensation requirements and a limited agency review process. In many cases, such as Nationwide 5, 13, 14, 18, and 26, depending on specific project circumstances, no notification of the USACE District Engineer is necessary. However, Nationwide Permits 7, 17, 21, 33, 37, and 38 require notification at all times.

Projects with impacts requiring an individual permit must comply with the Section 404 (b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230). These guidelines specify that an alternatives analysis must be conducted to determine which alternative has the greatest amount of wetland avoidance and minimization and requires compensation for impacts that cannot be avoided.

Under NEPA (10 CFR 1022), federal facilities must comply with Executive Order 11990, Protection of Wetlands (May 24, 1977). Federal agencies must ensure the consideration of wetlands protection is incorporated into the decision-making process through preventing, to the extent possible, the destruction, loss, or degradation of wetlands, and must also encourage the enhancement of natural and beneficial values of wetlands. According to NEPA, to the extent possible, any action that may occur within a wetland must be carefully evaluated and alternatives considered.

EPA guidance regarding wetland mitigation requirements for projects at the Site has been outlined in a letter dated November 29, 1993 regarding Wetland Mitigation for Surface Water Monitoring Stations. In summary, EPA has interpreted that Executive Order 11990 invokes compliance with Section 404 (b)(1) Guidelines (40 CFR 230) for any impacts or activities within wetlands at the Site. Based on this guidance, all activities with the potential to impact wetland areas, even if covered by a nationwide permit under the CWA, must comply with requirements to conduct an evaluation of alternatives, and select an alternative that has the greatest avoidance and minimization of, and compensation for, any wetland impacts.

5.2.2.6 Species and Habitat Protection Requirements

The Endangered Species Act of 1973 provides for the conservation of federally listed threatened and endangered species, and requires that federal agencies consider endangered or threatened species of fish, wildlife, or plants and habitat in actions affecting the environment. Actions include any direct or indirect impacts that modify the land, water, or air. The act restricts federal agencies from actions which result in the destruction or adverse modification of critical habitat.

Two other federal laws, the Migratory Bird Treaty Act and the Eagle Protection Act, provide additional protection for the Bald and Golden Eagle and migratory birds. The Colorado Nongame, Endangered and Threatened Species Conservation Act provides administrative protection for listed species of concern. These four laws are potential ARARs for the pond management actions.

Table 5-2 lists the federally threatened, endangered, and candidate species identified by the U.S. Fish and Wildlife Service (FWS) as species that could occur in the vicinity of the Site. The FWS has included threatened and endangered species that occur along the Platte River in Nebraska, because of the potential impact on these species if flows are depleted in the Platte River system as a result of pond management. The assessment of potential water depletion to the Platte River is addressed in Chapter 7. Table 5-2 outlines the Colorado Species of Special Concern that may occur near or at the Site. Background information and a discussion of the specific occurrence of these species follows. Additional discussion of habitat and species occurrence is found in Appendix A.

Three bird species have been classified by the Colorado Department of Wildlife as Species of Special Concern during migration periods: (1) the Barrow's goldeneye, *Bucephala islandica*; (2) the American white pelican, *Pelecanus erythrorhynchos*; and (3) the greater sandhill crane, *Grus canadensis tabida*. Additionally, the Barrow's goldeneye is a potential winter resident of the ponds although nesting sites have not been found. The white pelicans are possible migrants in the pond areas during seasonal migration and the greater sandhill crane has been sighted during the seasonal migration and would be expected to be associated with the aquatic areas (EG&G 1994).

The American peregrine falcon, *Falco peregrinus*, is a federally listed endangered species that nests in high precipitous cliffs and river gorges. Peregrine falcons are infrequent visitors to the Site. Occasionally they come in the spring and summer months to search for prey. There are only five known active or historic nesting sites along the Front Range near the Denver metropolitan area. The closest active nest is in the foothills west of Boulder, about eight miles northwest of the Site. In the spring of 1994, two Peregrine falcons were observed in the Buffer Zone (Nesla 1994). The area near the Site is included in the hunting territory for this falcon pair.

According to the *Baseline Biological Characterization of Terrestrial and Aquatic Habitats* (EG&G 1992) at the Site, bald eagles, *Haliaeetus leucocephalus*, occur as regular visitors during the winter, or as a migrant during spring and fall migration. It has not been demonstrated that bald eagles feed from the Site pond system and currently there is no designated bald eagle critical habitat associated with the ponds. However, impacts to the prairie dog or ferruginous hawk populations may have a negative impact on the bald eagles due to the interrelationship of these species with eagles. Prairie dogs are a food source and eagles frequently steal prairie dogs captured by ferruginous hawks.

The Preble's Jumping Mouse, *Zapus hudsonius preblei*, is currently under review for federal listing on the Endangered and Threatened Wildlife and Plants list. According to the Colorado Natural Heritage Program, the Preble's Jumping Mouse is rare with usually between 5 and 20 populations or occurrences. The state of Colorado lists this species as a Species of Special Concern. While Species of Special Concern are not protected by state statute, this species is a candidate for federal listing. The mapped potential habitat of the Preble's Jumping Mouse includes large areas of the A- and B-series drainages and ponds and the Woman Creek drainages (Figure 5-2). The Buffer Zone is home to one of two currently documented populations of the Preble's Jumping Mouse. The other site is located within the City of Boulder Open Space. The Preble's Meadow Jumping Mouse has been recorded from all major drainages at the Site, i.e., Rock Creek, Walnut Creek, Woman Creek, and Smart Ditch. The first mouse was captured in a range rehabilitation area in Woman Creek in May 1991. As of September 1994, there are 61 records of various jumping mice at the Site. Currently, further study is being conducted for the Preble's Jumping Mouse specific habitat and occurrence at the Site.

The Ute Ladies' Tresses orchid, *Sprianthes diluvialis*, a federally listed threatened plant species, has been found in Boulder and Jefferson Counties although has never been found at the Site. The critical habitat of this species is below 6,500 feet elevation, and includes seasonally moist soils, wet meadows near springs, lakes, or perennial streams, and associated floodplains. The areas highlighted on Figure 5-1 illustrate the Ute Ladies' Tresses Orchid potential habitat at the Site. As illustrated, the A-, B-, and C-series ponds are all within the habitat for the orchid. Additionally, North and South Walnut Creek, Woman Creek, and the SID are mapped as potential Ladies' Tresses habitat.

5.2.2.7 National Historic Preservation Act and Archeological and Historic Preservation Act

The National Historic Preservation Act requires CERCLA remedial actions to consider effects of the remedial activities on historic properties included on or eligible for inclusion on the National Register of Historic Places. The Archeological and Historic Preservation Act requires that any historical or archeological data that may be lost due to construction of a dam or alteration of the terrain be preserved (EPA 1989). No structures included on the National Register of Historic Places have been identified in the vicinity of the ponds and, therefore, these requirements are not potential ARARs.

5.2.2.8 Fish and Wildlife Coordination Act of 1934

This act provides a framework for coordination among federal agencies for the protection of fish and wildlife during federal actions which modify a natural stream or body of water. The type of actions which fall under the act include discharges of pollutants into waters or wetlands and construction of dams, levee impoundments, or water diversion projects. For any of these projects the agency in charge must outline measures which prevent, mitigate, or compensate for project-related losses to fish and wildlife. In developing these measures, the U.S. Fish and Wildlife Service and appropriate state agencies must be consulted. These requirements are required (applicable) for off-site actions but are relevant and appropriate for on-site actions such as dam improvements for the drainage ponds (EPA 1989).

5.2.2.9 Resource Conservation and Recovery Act and Colorado Hazardous Waste Act

The Resource Conservation Recovery Act (RCRA) sets forth requirements for material defined as hazardous waste under 40 CFR 261. The state similarly defines and regulates hazardous waste under the Colorado Hazardous Waste Act (CHWA). Through the "contained-in" policy, an interpretation of 40 CFR Part 261, EPA and the CDPHE require that environmental media such as surface water contaminated with a listed or characteristic hazardous waste be managed as a hazardous waste until it "no longer contains the waste."

To date, EPA has not issued specific guidance as to when, or at what levels, a medium no longer contains a hazardous waste. Instead, EPA regional offices and authorized states determine the levels on a case-by-case basis. CDPHE employs either a risk assessment process or existing promulgated standards in making a determination as to whether water contains hazardous waste. The risk assessment approach requires a quantitative determination that the levels of contaminants do not present a health risk, while the second approach compares concentration levels to existing standards. Generally, if concentrations are less than the most stringent among WQCC water quality standards, SDWA standards (i.e., MCLs), or CWA standards (i.e., ambient water quality criteria), the medium no longer contains a hazardous waste (CDPHE 1993).

Important regulatory standards that apply to defined hazardous waste are the RCRA Subtitle C requirements including the land disposal restrictions (LDRs). The LDRs establish treatment levels that must be met prior to land disposal of a hazardous waste. After treatment, the disposal of the hazardous waste must be in compliance with the requirements of RCRA Subtitle C. The land disposal restrictions may be applicable or relevant and appropriate to pond water management options involving treatment and disposal of hazardous waste or environmental media, including pond water and sediment containing hazardous waste.

5.2.2.10 CWA and Clean Air Act Requirements

Stormwater discharges from industrial facilities are subject to NPDES permitting requirements which require that the Site develop a Stormwater Pollution Prevention Plan (SPPP) and implement best management practices (BMPs) to reduce pollutants in stormwater discharges. The state of Colorado has equivalent permitting requirements for stormwater based on BMPs. These requirements are applicable to stormwater discharges from the Site into the A-, B-, and C-series ponds. They may also be relevant and appropriate to any discharges from Ponds A-4 and B-5 that are primarily stormwater.

Federal and state air pollution control standards are applicable to air emissions from remedial actions and are therefore both action-specific and chemical-specific standards. Of particular concern are the total suspended particulates (TSP), PM-10 (particulate matter less than 10 microns in size), and nitrogen oxide emissions from existing or new diesel-fueled generators and water pumps employed in pond water management strategies. The federal Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) and National Emission Standards for Hazardous Air Pollutants (NESHAPs) for a limited number of constituents. Air quality limits established by the Colorado Air Quality Control Commission (AQCC) are summarized in Table 5-3. While on-site remedial actions do not require air quality permits, the substantive requirements must be met, and include emission limits, emission control technologies, and monitoring and reporting activities. Additionally, an Air Pollution Emission Notice (APEN) must be filed for each source that meets the description in AQCC Regulation 3.

5.2.2.11 Dam Safety Requirements

Although there are several regulations and DOE orders that place requirements on the operation of the dams at the Site, these regulations cannot be considered "environmental laws."

Under CERCLA, remedial actions are to attain standards promulgated under environmental laws and thus the term ARAR has been reserved for these requirements. While dam safety requirements do not meet the CERCLA definition of an ARAR, they are critical to pond water management decisions and are therefore discussed in detail in Chapter 3.

5.3 SUMMARY OF POTENTIAL ARARS AND TBCs

The potential ARARs summarized below are intended to establish goals for implementation of the pond water management alternatives evaluated in Chapter 6. Each alternative will be assessed as to its ability to achieve these potential ARARs.

Water quality goals for pond water discharges are shown in Table 5-4. The potential ARARs and TBCs selected represent water quality goals that are protective of human health and environment, and were selected through the evaluation of COCs, MCLs, MCLGs, AWQC, and Segment 4 and 5 standards of the WQCC. The selected potential ARARs are also representative of best available technologies with regard to detection of contaminants. Consistent with WQCC regulations for organics, in instances where the PQL is above the promulgated standard, the PQL is the appropriate discharge goal.

For water quality parameters other than radionuclides, the WQCC stream standards for Segments 4 and 5 are selected as the water quality goals. These standards are as stringent or more stringent than CWA and SDWA standards and, thus, are applicable for establishing discharge limits for routine discharges for non-radionuclides from the ponds.

For radionuclides, DOE DCGs are selected as the water quality goals, based on their status as TBCs. The DCGs do not meet the definition of an ARAR because they are not promulgated. The DCGs are health-based standards that ensure protection of drinking water supplies and are, therefore, appropriate measures of the effectiveness of the alternatives. However, as a matter of comity, DOE agrees to use the Segments 4 and 5 radionuclide standards as a basis for assessing water quality.

For COCs without a Segment 4 or 5 WQCC stream standard, WQCC statewide standards of general applicability are listed. In cases where more than one value is contained in the statewide standards, the most conservative value, consistent with the segment classifications, was selected. For example, if both chronic and acute values are included in the regulations, the more stringent chronic value is shown in Table 5-4. In instances where no WQCC stream standard has been established, the CWA AWQC, for protection of aquatic life or protection of human health, or the SDWA MCL is listed.

With the exception of the National Historic Preservation Act and the Archeological and Historic Preservation Act, the laws discussed in Sections 5.2.2.3 through 5.2.2.8 establish relevant and appropriate requirements for activities related to the ponds and are therefore potential ARARs. These potential ARARs are expected to affect the pond water management alternatives through modification of activities (e.g., discharge timing and volumes, pond levels) which affect specific wetlands or habitat. The pond water management alternatives discussed in Chapter 6 of this document detail how the requirements of the location-specific ARARs are achieved.

40 CFR Part 261.4(a) excludes from the definition of a hazardous waste, wastes that pass through a sewer system to a publicly owned treatment works and industrial discharges that are point source discharges subject to regulation under Section 402 of the CWA. Under this exemption, water discharged from the WWTP and stormwater which is subject to the NPDES permit under Section 402 of the CWA cannot be classified as a hazardous waste nor can contain a hazardous waste. This exemption applies to all water that routinely enters Ponds A-3, A-4, B-3, B-4, B-5, and C-2, as these ponds only receive WWTP effluent or stormwater. The interior ponds, A-1, A-2, B-1, and B-2, may intercept water that is other than WWTP effluent or stormwater and therefore may contain a hazardous waste. Prior to transfers or actions with waters from the interior ponds, a hazardous waste determination in accordance with CDPHE guidance will be performed. In the event that non-stormwater or non-WWTP effluent enters Ponds A-3, A-4, B-3, B-4, B-5, and C-2, a hazardous waste determination may be required. Details regarding implementation and monitoring for a hazardous waste determination are discussed in Chapter 7.

Discharges that are primarily storm-related, such as stormwater runoff influent to ponds, are more appropriately covered under the CWA stormwater regulations and the NPDES permit requirements. Of the alternatives evaluated in Chapter 6, only those alternatives that involve active water treatment are anticipated to require compliance with air quality regulations.

The many existing programs that govern water quality in influent waters to the ponds are regulatory and administrative controls that will continue to operate. These include emergency planning and preparedness and the numerous spill prevention programs. In addition, procedures to ensure dam safety through monitoring and control of pond water volume, while not potential ARARs, remain as important controls for pond water management.

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TABLE 5-1
POTENTIAL FEDERALLY-LISTED SPECIES OF CONCERN THAT MAY OCCUR ALONG THE COLORADO FRONT RANGE NEAR THE SITE

Endangered Species	
Birds	American Peregrine Falcon (*Falco peregrinus*)[1]
	Bald Eagle (*Haliaeetus leucocephalus*)[2]
	Eskimo Curlew (*Numenius borealis*)
	Mexican Spotted Owl (*Strix occidentalis*)
	Southwestern Willow Flycatcher (*Empidonax traillii extimus*)
Mammals	Black-footed Ferret (*Mustela nigripes*)[3]
Threatened Species	
Plants	Ute Ladies' Tresses (*Spiranthes diluvialis*)
Insects	Pawnee Montane Skipper (*Hesperia leonardus montana*)
Candidate Species	
Plants	Colorado Butterfly Plant (*Gaura neomexicana var. coloradensis*) (C-1)
	Bell's Twinpod (*Physaria Bellii*) (C-2)
Insects	Regal Fritillary Butterfly (*Speyeria idalia*) (C-2)
	Ethmid Moth (*Ethmia monachella*)
Fish	Plains Topminnow (*Fundulus sciadicus*) (C-2)
Birds	Baird's Sparrow (*Ammodramus bairdii*)[2](C-2)
	Northern Goshawk (*Accipiter gentilis*) (C-2)
	Loggerhead Shrike (*Lanius ludovicianus*)[2] (C-2)
	Ferruginous Hawk (*Buteo regalis*)[2] (C-2)
	Western Snowy Plover (*Charadrius alexandrinus nivosus*) (C-2)
	Mountain Plover (*Charadrius montanus*) (C-1)
	Black Tern (*Chlidonias niger*) (C-2)
	White-faced Ibis (*Plegadis chihi*) (C-2)
Mammals	Spotted Bat (*Euderma maculatum*) (C-2)
	Fringed-tailed Bat (*Myotis thysanodes pahasapensis*) (C-2)
	Swift Fox (*Vulpes velox*) (C-2)
	Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*)[b] (C-2)

[1]The species *Falco peregrinus* is listed as endangered wherever found in the conterminous 48 states. Some subspecies are listed separately.
[2]This species is resident or regularly visits the Site.
[3]The species has not been reported in the general project area for over 50 years.
C-1: FWS has enough data on file to indicate potential need for listing as threatened or endangered.
C-2: FWS is currently acquiring data to indicate the potential need for listing as threatened or endangered.

Source: Biological Assessment for the Standley Lake Protection Project, CH2M Hill, May 27, 1994.
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TABLE 5-2
POTENTIAL STATE LISTED SPECIES OF CONCERN THAT MAY OCCUR ALONG THE COLORADO FRONT RANGE NEAR THE SITE

Colorado Species of Special Concern	
Plants	Forktip Threeawn (*Aristida basiramea*)[1]
	Gay-feather (*Liatris ligulistylus*)
	Toothcup (*Rotala ramosior*)
	Black Spleenwort (*Aspelenium adiantum-nigrum = A. andrewsii*) (C-3B)
	Tulip Gentian (*Eustoma grandiflora*)
	Yellow Stargrass (*Hypoxis hirsuta*)
	Adder's Mouth Orchid (*Malaxis brachypoda*)
	Pale Moonwort (*Botrichium pallidum*)
	Purple Ladies Slipper (*Cyripedium fasiculatum*)
	Araapien Stickleaf (*Mentzelia argillosa*)
Fish	Common Shiner (*Notropis cornutus*)
	Stonecat (*Noturus flavus*)
Birds	Barrow's Goldeneye (*Bucephala islandica*)
	Long-billed Curlew (*Numenius americanus*) (C-3C)[2]
	Plains Sharp-tailed Grouse (*Tympanuchus phasianellus jamesi*)
	Greater Sandhill Crane (*Grus cnandensis tibida*)
	American White Pelican (*Pelecanus erythrorhynchos*)[2]

[1]This species is resident or regularly visits the Site.
[2]The species has been observed infrequently at the Site.
C-3B: These taxa are not recognized as distinct species by FWS, but may be reevaluated in the future.
C-3C: These taxa have been proven more abundant than previously believed. FWS may reevaluate them in the future.

Source: Biological Assessment for the Standley Lake Protection Project, CH2M Hill, May 27, 1994.

TABLE 5-3
COLORADO AIR QUALITY CONTROL COMMISSION STANDARDS

(State of Colorado, Regulation 3)

Criteria Pollutants (NAAQS)

CO, SO_2, NO_2, Particulate Matter (TSP), O_3, Pb

<u>TSP (Total Suspended Particulates) - Colorado State Implementation Plan (SIP) for Metropolitant Denver</u>

	Primary Std	Secondary Std	
Annual	75 $\mu g/m^3$	60 $\mu g/m^3$	Annual arithmetic mean
24-Hour	260 $\mu g/m^3$	150 $\mu g/m^3$	Not exceeded more than 1x/year

<u>SO_2 Sulfur Dioxide - Colorado SIP</u>

Incremental--->	Category 1	Category 2	Category 3
Annual Arithmetic Mean	2 $\mu g/m^3$	10 $\mu g/m^3$	15 $\mu g/m^3$
24-Hour Maximum	5 $\mu g/m^3$	50 $\mu g/m^3$	100 $\mu g/m^3$
3-Hour Maximum	25 $\mu g/m^3$	300 $\mu g/m^3$	700 $\mu g/m^3$

<u>O_2 (Ozone, Oxidant) - Colorado SIP for Metropolitan Denver</u>

Averaging Time/Standard	1 hour	160 $\mu g/m^3$

<u>CO (Carbon Monoxide) - Colorado SIP for Metropolitan Denver</u>

Averaging Time/Standard	8 hours	10 $\mu g/m^3$
Averaging Time/Standard	1 hour	40 $\mu g/m^3$

<u>NO_2 (Nitrogen Dioxide) - Colorado SIP for Metropolitan Denver</u>

Averaging Time/Standard	Annual	100 $\mu g/m^3$

<u>Pb (Lead) - Colorado SIP</u>

Averaging Time/Standard	Quarter	1.5 $\mu g/m^3$

TABLE 5-3
(Page 2 of 2)

Colorado Prevention of Significant Degradation (PSD) Requirements for Particular Pollutants

New Stationary Source Emissions or Net Emissions Increase from a Modification ---> PSD

Particular pollutant emissions from a new major source or major modification, which would cause air quality impacts in any area of Colorado, less than the following amounts, are not subject to Best Available Control Technology (BACT), monitoring and analysis requirements (Amounts at 25°C and at one atmosphere (1013 millibars)):

CO	8-hour average	575 $\mu g/m^3$
NO_2	Annual average	14 $\mu g/m^3$
PM-TSP	24-hour average	10 $\mu g/m^3$
PM-10	24-hour average	10 $\mu g/m^3$
SO_2	24-hour average	13 $\mu g/m^3$
Pb	3-month average	0.1 $\mu g/m^3$
Hg	24-hour average	0.25 $\mu g/m^3$
Be	24-hour average	1 ng/m^3, 0.001 $\mu g/m^3$
Fluorides	24-hour average	0.25 $\mu g/m^3$
Vinyl chloride	24-hour average	15 $\mu g/m^3$
Total reduced sulfur	1-hour average	10 $\mu g/m^3$
H_2S	1-hour average	0.2 $\mu g/m^3$
Reduce sulfur compounds	1-hour average	10 $\mu g/m^3$

TABLE 5-4
POTENTIAL ARARs AND TBCs FOR ROUTINE POND WATER DISCHARGES
(μg/L unless otherwise noted)

Parameter[1]	Type[2]	PQL[3]	Potential ARAR	TBC (To Be Considered)	References	Comment
Thallium	Metal (TR)		0.012		WQCC basic surface water standard - drinking water	Standard is 30-day average
Alpha BHC	Organic	0.5	0.0039		Segment 4 and 5 standard	
Beta BHC	Organic	0.05	0.014		Segment 4 and 5 standard	
1,2-Dichloroethene	Organic		70/100		WQCC basic surface water standard	Standard for cis/trans isomers
Napthalene	Organic	10	0.0028		Segment 4 and 5 standard	
Trichloroethylene	Organic	1.0	2.7		WQCC basic surface water standard - human health	
Trichloroethylene	Organic	1.0	66		Segment 5 standard	Temporary modification until April 1, 1996
Alkalinity	Inorganic		20,000		AWQC - aquatic life	Chronic value
Ammonia (un-ionized) (mg/L)	Inorganic		1.8 (Mar-Jun) 0.7 (Jul-Apr)		Segment 5 standard	Temporary modification until April 1, 1996
Ammonia as N (un-ionized) (mg/L)	Inorganic		0.10		Segment 4 and 5 standard	Standard is 30-day average
Cyanide	Inorganic		5		Segment 4 and 5 standard	Standard is for free cyanide
Fluoride	Inorganic		2000		WQCC basic surface water standard - domestic water supply	
Nitrite as N	Inorganic		500		Segment 4 and 5 standard	Standard is 1-day
Nitrite & Nitrate (mg/L)	Inorganic		10		WQCC basic surface water standard - water supply	Standard is for combined
pH	Inorganic		6.5-9.0		Segment 4 and 5 standard	
Sulfide	Inorganic		2		Segment 4 and 5 standard	Standard is 30-day average

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Parameter[1]	Type[2]	PQL[3]	Potential ARAR	TBC (To Be Considered)	References	Comment
Total Dissolved Solids (mg/L)	Inorganic		250		AWQC - human health	
Gross Alpha (pCi/L)	Radionuclide		15		SDWA MCL	
Gross Beta (mrem/yr)	Radionuclide		4		SDWA MCL	
Plutonium-239/-240 (pCi/L)	Radionuclide	0.2[4]		30	DOE DCG value	
Tritium[5] (pCi/L)	Radionuclide			1000	DOE DCG value	

[1]Potential ARARs and TBCs have been listed for the contaminants of concern established in Chapter 4.
[2]TR = Total Recoverable D = Dissolved
[3]Practical Quantification Limit, where standard is more stringent than the PQL, the PQL is taken as the compliance level.
[4]PQL is from the Water Quality Control Division of the Colorado Department of Health and Environment, 1992 Analytical Workshop on Practical Quantitation Levels, January 10, 1992.
[5]If both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 rem/year.

NOTE: For metals with both a 1-day and 30-day standard, the more stringent 30-day average is reported. Metals standards are based on 1-day average unless otherwise noted.

CHAPTER 6

DESCRIPTION AND EVALUATION OF PHYSICAL CONTROL ALTERNATIVES FOR POND WATER MANAGEMENT

This chapter describes the process used to evaluate and select viable physical control alternatives for pond water management. Six alternatives are evaluated, the criteria and methodology used in the evaluation process are described, and the results are documented.

In evaluating physical control alternatives and selecting appropriate evaluation criteria, certain assumptions must be made that apply to water sources influent to the ponds. These assumptions establish a framework for and limitations of the evaluation and the selection of physical control measures.

1. Discharges from the wastewater treatment plant (WWTP) must comply with the effluent limitations established by the National Pollutant Discharge Elimination System (NPDES) permit. For this document, it is assumed the new permit will require WWTP discharges to comply with numeric limits based on water quality standards established by the Colorado Water Quality Control Commission (WQCC). These numeric limits are Segment 4 or Segment 5 stream standards, depending on the point of discharge of the WWTP.

2. Under current Clean Water Act (CWA) regulations, most industries are required to apply for "general" or "individual" stormwater-related NPDES permits (40 CFR 122). These permits generally require the implementation of best management practices (BMPs) to prevent pollutants from entering stormwater prior to their being discharged to receiving waters and apply monitoring requirements for stormwater discharges.

   Rocky Flats Environmental Technology Site (the Site) has applied for, but has not yet received, a new NPDES permit for stormwater. A preliminary draft permit issued by the U.S. Environmental Protection Agency (EPA) contains six stormwater discharge points covering stormwater outfalls from the Industrial Area (IA) of the plant site (U.S. Department of Energy [DOE] 1994). For this document, it is assumed that stormwater discharges from the IA will be subject to the aforementioned BMP-level controls and monitoring requirements only, consistent with expected NPDES permit requirements.

Through its existing *Spill Prevention Control Countermeasures and Best Management Practices (SPCC/BMP) Plan*, the Site has identified and implemented many BMPs and other control measures recommended by EPA and the State of Colorado. It is assumed that these measures will limit the likelihood that pollution of pond water will occur from spills during dry or wet conditions.

3. Consistent with stormwater provisions of the draft NPDES permit, the evaluation of physical control measures assumes that specific numeric limits for water quality will not apply to buffer zone runoff, prior to this runoff entering the pond system. This runoff will be managed using a combination of stormwater BMPs required by the NPDES permit and the recommendations of the 1993 *Rocky Flats Integrated Watershed Management Plan* (IWMP) (EG&G 1993b). The IWMP provides BMPs guidance on the use of pesticides, protection of wetlands and habitat, mechanical weed control, and erosion control. Erosion control measures will help stabilize soils and reduce the amount of eroded material entering the ponds. It is expected that implementation of the IWMP will reduce the concentrations of pesticides entering the ponds.

4. With the exception of possible volatile organic compound (VOC) contamination in Pond B-2 and plutonium in Pond C-2, current water quality data (Chapter 4) do not indicate the need for immediate control measures. The VOC contamination is a result of contaminated groundwater plumes associated with Operable Unit (OU) 2. The plutonium contamination appears to be associated with seasonal conditions that impact contaminant runoff, pond water chemistry, and biological activity.

   Pond water management will be better coordinated and integrated with the IA IM/IRA as well as ongoing OUs 5, 6, and 7 Resource Conservation Recovery Act (RCRA) Facility Investigation/Remedial Investigations (RFI/RIs). With better coordination and integration, these activities are considered adequate to identify new or worsening water quality problems from these sources. Immediate response actions, if needed in the future, are undefinable at this time, and final remediation of these water sources will be addressed by other plans such as the RFI/RI and Corrective Measures Study/Feasibility Study (CMS/FS) for the OUs. Water quality problems identified by existing or new monitoring programs will be investigated to further reduce the input of contaminants to the drainage ponds.

5. The Site conducts discharges from the OU 1 and OU 2 IM/IRA treatment systems in accordance with the criteria established by the specific OU 1 and OU 2 applicable or relevant and appropriate requirements (ARARs). These discharges, which are influent to the pond systems, generally meet their

respective ARARs. Additional physical controls to specifically address OU discharges are not considered necessary as part of this document.

6. This document assumes that interpond transfers, releases from an upstream pond to a downstream pond, and off-site discharges from the ponds will be subject to both physical controls (retention behind dams) and administrative controls (monitoring requirements, discharge criteria). However, emergency conditions that have health and safety ramifications or that threaten damage or destruction of physical controls, although not anticipated, may require emergency transfers or discharges. These emergency transfers and discharges will take precedence over administrative controls and normal operational protocols. Conditions warranting emergency transfers or discharges are detailed in *Standard Operation Procedures*, the *Emergency Preparedness Implementation Plan* (EPIP), and the *Draft Emergency Response Plan for Water Detention Pond Dam Failure* (EG&G 1994a).

7. As previously discussed in Chapter 5, stormwater is not a hazardous waste. Therefore, RCRA containment requirements will not apply to existing or new treatment facilities intended to treat stormwater flows. However, RCRA requirements may apply to waste sludge or other waste streams generated as a result of treatment.

8. True zero-discharge of all waters from the Site is not feasible. This document assumes that off-site discharge of some water would continue, although the amount of water discharged off-site might decrease.

9. This document assumes that existing facilities remain in place, and that 500,000 gallons of off-channel tankage required in the IA IM/IRA has been constructed. This tankage will be used for storage of waters potentially impacted by WWTP upsets or spills to the WWTP.

10. This document assumes that Ponds A-1, A-2, B-1, and B-2 would remain available as the last point of management for spills, WWTP discharges, or other releases to stormwater or Site drainages. The dedication of these ponds to spill control will help to prevent the spread of contaminants as well as the off-site release of contaminants. Flows will not be routed through these ponds except in periods when there is concern that these waters might be contaminated. It is believed that existing administrative and engineering controls at the Site will minimize spills and releases requiring management in these ponds. However, it is impossible to reduce the risk of such spills to zero. The dedication of these ponds to spill control will help prevent the spread of contamination to the

larger drainage ponds as well as to help prevent the off-site release of contaminants.

11. For controlled detention discharge or modified controlled detention discharge options, a time period of no allowable discharge will follow storm events exceeding 0.5 inch in a 6-hour period. The current NPDES permit for the Site requires no discharge from the terminal ponds for 24 hours after such a storm event. However, the technical literature indicates that a 48-hour time period is more appropriate to allow for removal of the majority of sediment from stormwater. Thus, in the following controlled detention alternatives, a no-discharge period of 48 hours following a storm event of 0.5 inch is specified.

It is important to note that it is not possible for this or any other document to guarantee that upstream physical and administrative control measures will ensure that water sources influent to the ponds will comply with discharge standards. Therefore, the goal of the evaluation process is to select physical control options which effectively manage discharge water quantity and quality in accordance with appropriate physical and chemical criteria.

6.1 DESCRIPTION OF ALTERNATIVES

This section describes the physical control alternatives for pond water management selected for evaluation. Alternatives are described in terms of a systematic approach to water management reflective of the manner in which water can be discharged to off-site locations. All of the alternatives assume that off-site discharges will continue because achieving true zero discharge of waters from the Site is considered physically impossible. Alternatives that allow for discharge reductions were evaluated, however. The six alternatives evaluated for pond water management are listed below. The numbers assigned to each alternative below are used consistently throughout the text.

0. Continued Batch Discharge - No Action Alternative.
1. Continued Batch Discharge with Phased-In Pond Capacity Increases.
2. Continued Batch Discharge with Phased-In Water Consumption.
3. Continued Batch Discharge with Phased-In Direct Discharge of WWTP Effluent.
4. Continuous Treated Discharge with Phased-In Treatment Upgrades.
5. Controlled Detention and Discharge with Phased-In Real-Time Monitoring.

6. Seasonally Adjusted Controlled Detention and Discharge/Batch Discharge.

There are two basic ways in which water can be discharged. The first, known as batch discharge, involves collecting inflows in one or more ponds over a period of time, isolating this water from additional inflows, and discharging the accumulated volume of water as a distinct batch. The second method of discharge, known as controlled detention, results in discharges on a relatively continuous basis, depending on precipitation and other hydrologic considerations. Controlled detention relies on the inherent system detention time to allow settling of routine flows and stormwater generated from storms of less than 0.5 inch in a 24-hour period. Each of these approaches influences the chemical and biological profiles of the ponds differently, with corresponding and significant implications for pond water quality.

For the batch discharge alternatives, chemical and physical stratification of the ponds is known to occur, particularly in the summer months. Vertical variations in parameters, such as pH, dissolved oxygen, temperature, and redox potential, may contribute to remobilization of constituents from pond sediments, particularly metals, which have been identified as contaminants of concern (COCs). Alternatively, the controlled detention alternatives decrease the opportunity for stratification, especially for shallow ponds, like those at the Site, but they also decrease the time available for potentially contaminated suspended sediments to settle out of the water column. Stormwater literature indicates that 48 hours of detention allows most sediments entrained in stormwater to settle out. This detention time is possible at the Site for all but the largest storms with no further discharge controls. Detention times for the ponds at the Site are further addressed in the discussion of water management alternatives involving controlled detention and discharge. Water quality implications such as these are addressed in evaluation of alternatives.

Constraints on the current mode of operation exist due to dam safety considerations. The design of the A-4, B-5, and C-2 dams was based on normal operating levels in the ponds of 10 percent of the maximum capacity. This design assumed that stormwater entering the ponds would be released shortly (i.e., days) after collection. However, in 1989 the average period of retention of waters in the ponds was lengthened in order to allow for analysis of the retained stormwater. Similarly, analytical turnaround time for the samples collected was lengthy. This was due, in part, to the large number of analytes requiring analysis from 1989 onward. As a consequence, these three terminal ponds have routinely held volumes greater than 10 percent for up to several months in an effort to achieve batch discharge. Storm events occurring after initial batch sample collection could require a second or even a third round of sampling and analysis prior to discharge. These issues and concerns have helped contribute to larger retained water volumes within the ponds, possibly compromising dam safety.

Dam safety operating constraints for the three terminal ponds are also considered in the analysis of alternatives. These operating constraints were determined by EG&G Engineering staff based on stability analyses and failure mode calculations performed by the U.S. Army

Corps of Engineers (USACE). Maximum long-term safe holding capacities in the three terminal reservoirs corresponding to assumed minimum safety factors of 1.2 are 65 percent of maximum capacity for Ponds A-4 and C-2, and 50 percent of maximum capacity for Pond B-5.

Alternatives 1, 2, and 3 describe various system options for conducting batch discharges. Alternatives 4 and 5 describe two alternatives for conducting discharge after controlled detention. Alternative 6 is a hybrid alternative which includes both batch discharges and controlled detention discharges on a seasonally adjusted basis. All the alternatives described and evaluated in this section are short-term in nature, consistent with the intent of an interim measure. For each alternative, the existing system components that can be used are identified, followed by a brief listing of the required changes or needed improvements to implement the alternative.

The following sections present brief descriptions of the various alternatives.

6.1.1 Alternative 0: No Action Alternative

Alternative 0 is the no action alternative for evaluation purposes. This alternative essentially consists of managing and operating the drainage ponds in the same manner that they have been managed since 1989. Available data indicate that discharge of untreated water in this manner achieves Segment 4 standards greater than 95 percent of the time.

The no action alternative represents current operational facilities, monitoring programs, and protocols, and can be categorized as a batch discharge scenario, with exceptions. Current operational practices are described in detail in Chapter 3. In theory, stormwater and other flows are held in Ponds B-5 and A-3 until sufficient volume is accumulated to warrant transfer of these ponds to Pond A-4. After transfer to Pond A-4 is completed, the water is sampled for a full suite of analytes, and held until analytical results are received and the Colorado Department of Public Health and Environment (CDPHE) concurs on the acceptability of this water for discharge. Discharges from Pond A-4 take place over a discrete 7- to 10-day period and are discontinued when Pond A-4 levels drop to near 10 percent of maximum capacity. A new discharge cycle (transfer Ponds A-3/B-5 to Pond A-4, sample Pond A-4, discharge Pond A-4) is then initiated.

Historically, the mode of operation described above for Ponds A-3, A-4, and B-5 results in a typical batch discharge cycle of between 32 and 38 days. Seasonal hydrologic conditions, combined with the limitations on operating capacity and drawdown rates, routinely require short circuiting of the batch discharge cycle. "Short circuiting" the batch cycle means that to satisfy the inflow and dam safety concerns, water in Pond B-5 and/or Pond A-3 is transferred to Pond A-4 before Pond A-4 has finished a discharge cycle. True batch mode operations, characterized by receipt of complete pre-discharge analytical results of water released from Pond B-5 or A-3, is not possible.

The current mode of operation requires long holding times and results in occasional releases of unmonitored water from the ponds due to dam safety constraints. The long holding times and greater pond volumes also cause changes in pH, dissolved oxygen, and algal blooms negatively affecting water quality.

Assuming the no action alternative is rejected, the alternatives that follow attempt to address the competing concerns described above by identifying improvements or changes to physical facilities that will allow true batch discharge to occur, or by improving monitoring programs to provide assurance that controlled detention operations can be conducted safely.

6.1.2 Alternative 1: Continued Batch Discharge with Phased-In Pond Capacity Increases

This alternative involves detaining stormwater runoff, WWTP effluent, and other inflows in Ponds A-3 and B-5, transferring Ponds A-3 and B-5 to Pond A-4 for isolation and pre-discharge sampling, and releasing the isolated volume in Ponds A-4 and C-2 downstream once sampling results are received. This alternative closely resembles current operations. It evaluates whether modification of the dams to increase rated operating capacity will eliminate the need to short circuit the batch discharge cycle.

Current System Components

- Pond A-3 operating range: Minimum - 1.2 Mgal, 10%; Maximum 11.2 Mgal, 90%
- Pond B-5 operating range: Minimum - 2.4 Mgal, 10%; Maximum - 12.0 Mgal, 50%
- Pond A-4 operating range: Minimum - 3.3 Mgal, 10%; Maximum - 21.1 Mgal, 65%
- Pond C-2 operating range: Minimum - 2.3 Mgal, 10%; Maximum - 14.7 Mgal, 65%
- Maximum drawdown rates for Ponds A-4, B-5, and C-2 are one foot per day
- Maximum drawdown rate for Pond A-3 is three feet per day
- Maintain current treatment systems at Ponds A-4 and C-2 in standby mode
- Pre-discharge sampling continued at Pond A-4
- 32- to 38-day discharge cycle
- 212 water quality parameters analyzed prior to release

Required Changes and Improvements

- Structurally modify the dams to consistently retain a maximum capacity of 80 percent for a greater length of time (minimum 45 days), and/or increase drawdown capability to safely exceed the current one foot per day restriction.

- Install new piezometers and inclinometers to better assess the conditions within the dams and tie into the real-time monitoring network.

In this alternative, the dams would be strengthened by flattening the slopes on the upstream and/or downstream faces. This would increase the available capacity of dams B-5 and A-4 to allow storage up to 80 percent of their full capacity (19.2 million gallons and 26.0 million gallons, respectively). An increase in allowable storage to 80 percent allows for much more successful operation in a batch mode.

6.1.3 Alternative 2: Continued Batch Discharge with Phased-In Water Consumption

This alternative has the same general description as Alternative 1, with the exception that instead of modifying the dams to retain larger volumes, this alternative reduces water volumes by implementing consumptive uses such as spray evaporation, spray irrigation, wetlands enhancement, recycling, or new evaporation ponds. Evaluation of this alternative will determine if any one, or a combination, of these consumptive uses will allow batch discharge operations to be conducted within the constraints of safe operating capacities, seasonal hydrologic conditions, and water quality considerations.

A number of studies have been conducted at the Site for the purpose of minimizing or eliminating off-site discharges of water. These studies have included:

1. *Engineering Study for Water Control and Recycle* completed by Engineering-Science, Inc. in 1975 (Contract AT(29-2)-3413);

2. *Processing Woman Creek Runoff Water by Reverse Osmosis* by Rockwell International, 1981;

3. *Water Use and Conservation Plan* by Rockwell International, 1987;

4. *Treated Sewage/Process Wastewater Recycle Study, Rocky Flats Plant Site*, Tasks 11 and 13 of the Zero-Offsite Water-Discharge Study by Advanced Sciences, Inc. June 11, 1991;

5. *Surface Water Evaporation Study, Rocky Flats Plant,* Task 15 of the Zero-Offsite Water-Discharge Study by ASI, Draft, April 23, 1991; and

6. The Pond C-2 Recycle Studies Conducted by EG&G in 1991 and 1992.

Some of the recommendations resulting from these studies have been implemented.

From 1979 until March 1990, spray irrigation of Pond B-3 water was conducted at the Site. Available data indicate that spray irrigation at the east spray field was capable of reducing off-site discharges by 40 to 60 million gallons per year. Water was consumptively used through evapotranspiration by vegetation and by infiltration of irrigation water.

East spray field irrigation was halted in March 1990 by a DOE directive because of uncertainties regarding the definition of "good engineering practices" and "hazardous waste." The definitions of these terms were critical to some of the ongoing Federal Bureau of Investigation raid and Grand Jury activities of 1990. However, when the Grand Jury activities were settled, additional clarification and definition of these terms had been determined. Count 5 of the Plea Agreement addressed east spray field operations, citing the operations as not meeting the definition of "good engineering practices" because of spray irrigation operations when the ground was frozen. Hazardous waste concerns were not identified in Count 5. Spray irrigation may again be a viable water management practice for waters meeting stream segment standards or other risk-based criteria.

Resumption of spray irrigation activities at the east spray field could result in substantial reductions in off-site water discharges. The location of spray irrigation, or other consumptive use activities, under this option may vary. If spray evaporation or spray irrigation practices are resumed, increased pond water monitoring will be necessary as will detailed procedures for operation of the system. These data will be used to determine whether or not potential negative impacts associated with these activities are occurring. Two examples of potential negative impacts include the concentration of some non-volatile compounds, including COCs, in a reduced volume of water, or the increased air release of compounds, including COCs.

Current System Components

- Pond A-3 operating range: Minimum - 1.2 Mgal, 10%; Maximum - 11.2 Mgal, 90%
- Pond B-5 operating range: Minimum - 2.4 Mgal, 10%; Maximum - 12.0 Mgal, 50%
- Pond A-4 operating range: Minimum - 3.3 Mgal, 10%; Maximum - 21.1 Mgal, 65%
- Pond C-2 operating range: Minimum - 2.3 Mgal, 10%; Maximum - 14.7 Mgal, 65%
- Spray evaporation system at Pond A-2
- Discharge of excess water will be consistent with Alternative 1 (batch discharge)
- Maximum drawdown rates for Ponds A-4, B-5, and C-2 are one foot per day
- Maximum drawdown rate for Pond A-3 is three feet per day
- Pre-discharge sampling continued at Pond A-4
- 32- to 38-day discharge cycle
- 212 water quality parameters analyzed prior to release

Required Changes and Improvements

- Construct spray evaporation systems and/or other consumptive use projects to reduce the volume of water requiring discharge from the Site
- Construct spray irrigation systems in appropriate locations to further reduce the amount of water within the pond management system
- Recycle stormwater for reuse, and/or construct new wetlands or evaporation ponds, and/or implement new upstream monitoring, and/or conduct more frequent ambient pond monitoring
- A water augmentation plan to address water rights issues

The utility of consumptive uses to achieve batch discharges, limit off-site discharges, and achieve lower routine pond levels at any or all ponds is entirely dependent on the regulatory and public acceptability of the practice. From a technical standpoint, land irrigation consumptive uses of approximately 40 million gallons per year appear feasible. This amount of consumptive use or discharge reduction would be effective in nearly eliminating the need for off-site discharge of WWTP flows, as was done from 1979 to 1983. Implementation of this option will require the examination of water rights implications of the consumptive uses.

6.1.4 Alternative 3: Continued Batch Discharge with Phased-In Direct Discharge of WWTP Effluent

This alternative is the same as Alternative 2, with the exception that instead of controlling routine volumes through consumptive uses, retained volumes will be controlled by removing WWTP effluent from the pond system, and discharging it directly to Segment 4 below the ponds. Evaluation of this alternative will determine whether removing WWTP effluents from batching requirements at Pond A-4 will allow all other inflows to the pond system to be batched, given the constraints of current operating capacities, seasonal hydrologic conditions, and water quality considerations. Although discharge of WWTP flows to Segment 1 is a possibility, discharge to Segment 4 appears more feasible due to right-of-way issues associated with discharge to Segment 1. These WWTP discharges to Segment 4 or 1 would be made under the terms and conditions of the new NPDES permit.

Current System Components

- Pond A-3 operating range: Minimum - 1.2 Mgal, 10%; Maximum - 11.2 Mgal, 90%
- Pond B-5 operating range: Minimum - 2.4 Mgal, 10%; Maximum - 14.7 Mgal, 65%
- Pond A-4 operating range: Minimum - 3.3 Mgal, 10%; Maximum - 21.1 Mgal, 65%

- Pond C-2 operating range: Minimum - 2.3 Mgal, 10%; Maximum - 14.7 Mgal, 65%
- Maximum drawdown rates for Ponds A-4 and B-5 are one foot per day
- Maximum drawdown rate for Pond A-3 is three feet per day
- Pre-discharge sampling continued at Pond A-4
- 32- to 38-day discharge cycle for stormwater
- 212 water quality parameters analyzed prior to release

Required Changes and Improvements

- Extend WWTP discharge pipe to outfall below Pond A-4 (or B-5). Coordinate pipeline construction with installation of WWTP effluent tanks under the IA IM/IRA.
- Install real-time analytical monitoring equipment for indicator parameters on the WWTP.

Removing WWTP effluent flows from the ponds has substantial operational benefits. On an annual basis, the WWTP comprises approximately ½ of the total volume of water discharged from the Site and approximately ¾ the water passing through the South Walnut Creek (i.e., B-series) drainage.

6.1.5 Alternative 4: Continuous Treated Discharge with Phased-In Treatment Upgrades

Under this alternative, stormwater inflows, WWTP effluent, and other inflows will flow continuously to Ponds B-5 and A-4. In addition, water in Pond B-5 will be continuously pumped to Pond A-4 depending on the available capacity of Pond A-4. Water in Pond A-4 will be continuously pumped through the existing treatment system and discharged to Segment 4. Treatment system upgrades at Pond A-4, specifically for metals and radionuclides, will be phased-in over time. Evaluation of this alternative will determine treatment system components and treatment system throughput capacity necessary to maintain safe pond levels given the constraints imposed by seasonal hydrologic conditions. Pond volumes in A-4, B-5, and C-2 will be maintained at approximately 10 percent of maximum capacity. As currently required in the NPDES permit, precipitation events greater than 0.5 inch will require off-site discharges to cease until newly-collected water has been allowed to settle for a minimum of 24 hours. In typical stormwater detention ponds, the majority of sediment is removed within 48 hours (Stahre and Urbonas 1990).

Current System Components

- Water treatment system at Pond A-4 consisting of primary filtration (10 μm), secondary filtration (0.5 μm), and granular activated carbon (GAC). Maximum flow rate is 1200 gpm.

- Pumps and transfer pipelines from Ponds B-5 and C-2 to Pond A-4
- Pond A-4 operating range: Minimum - 3.3 Mgal, 10%; Maximum - 21.1 Mgal, 65%
- Pond B-5 operating range: Minimum - 2.4 Mgal, 10%; Maximum - 12.0 Mgal, 50%
- Pond C-2 operating range: Minimum - 2.3 Mgal, 10%; Maximum - 14.7 Mgal, 65%

Required Changes and Improvements

- Upgrade treatment capabilities at Pond A-4 for metals, radionuclides, non-GAC organics, and/or water quality parameters.
- Upgrade treatment site for secondary containment.
- Construct separate facilities for storage of sludges, used media, and other consumables contaminated with low level radioactivity and/or RCRA wastes.
- Implement new upstream monitoring.
- Specify turbidity limitations for transfers to Pond A-4.

Continuous treatment of discharge water provides the greatest assurance that low level contamination will be mitigated prior to release. However, high construction and operational costs, increased waste generation, and increased energy consumption will also be experienced if this alternative is implemented.

6.1.6 Alternative 5: Controlled Detention and Discharge with Phased-In Real-Time Monitoring

This alternative involves: (1) controlled detention of stormwater, WWTP effluent, and other inflows to Ponds A-4, B-5, and C-2, and (2) continuously monitored discharges from the outlet works of Ponds A-4 and B-5, and possibly Pond C-2 under routine operating conditions. Pond C-2 may be discharged directly or pumped to Pond A-4 for discharge. Ponds A-4, B-5, and C-2 will be maintained near 10 percent of their maximum capacity.

Under this alternative, flows will be discontinued during unattended periods (nights/ weekends), during storm events greater than 0.5 inch in 24 hours, and if spills occur. Holding periods and turbidity limits for transfers will be specified to ensure that stormwater has sufficiently settled to minimize sediment transport. Real-time analytical equipment for selected indicator parameters will be installed at various locations throughout the pond system to provide early detection and response to potential water quality problems, such that suspect water is captured and retained as far upstream as possible. Phased implementation of this alternative will be required to generate the data used to determine relationships between COCs and indicator parameters. The data and statistical relationships generated through phased implementation will allow selection of the combination of real-time analytical equipment and laboratory analyses to ensure that discharge water quality will achieve the performance goals established for this document. Analytical monitoring of discharge water quality would continue to be conducted to ensure the reliability of the real-time monitoring system.

Current System Components

- Pumps and transfer pipelines from Ponds B-5 and C-2 to Pond A-4
- Existing dams and outlet works
- Pond A-3 operating range: Minimum - 1.2 Mgal, 10%; Maximum - 11.2 Mgal, 90%
- Pond B-5 operating range: Minimum - 2.4 Mgal, 10%; Maximum - 12.0 Mgal, 50%
- Pond A-4 operating range: Minimum - 3.3 Mgal, 10%; Maximum - 21.1 Mgal, 65%
- Pond C-2 operating range: Minimum - 2.3 Mgal, 10%; Maximum - 14.7 Mgal, 65%
- Current network of real-time monitors for flow and water quality parameters upstream of the A-1 and B-1 Bypasses and on discharge pipe from Pond A-4. Real-time pond level monitors at Ponds A-4, B-5, and C-2. Real-time piezometer monitors at Pond B-5.

Required Changes and Improvements

- Install real-time analytical systems and upgrades to the current telemetry network to monitor the major influent streams (WWTP, A-1 Bypass, B-1 Bypass) and final discharges from Ponds A-4 and B-5, and possibly Pond C-2, for alpha radioactivity, volatile organics, metals, inorganic contaminants, as well as pH and other traditional water quality parameters identified as COCs in Chapter 4.
- Install appropriate system alarms at attended control panel locations.

Adequate detention time (greater than 48 hours) will be available at nearly all times for stormwater management. Therefore, it is expected that water quality discharged in this scenario will generally meet Segment 4 standards. This alternative also has the greatest operational flexibility of all the alternatives.

6.1.7 Alternative 6: Seasonally Adjusted Controlled Detention and Discharge/Batch Discharge

This alternative involves conducting batch discharge operations similar to those described in Alternative 1 during most of the year, and conducting controlled detention operations with upgraded real-time monitoring during high flow periods (generally the months of March, April, and May). Additional data evaluation will determine the seasonal hydrologic conditions that warrant controlled detention operations, given the constraints imposed by safe pond capacities, performance goals for water quality, and the desire to conduct batch operations during most of the year.

Current System Components

- Pond A-3 operating range: Minimum - 1.2 Mgal, 10%; Maximum - 11.2 Mgal, 90%
- Pond B-5 operating range: Minimum - 2.4 Mgal, 10%; Maximum - 12.0 Mgal, 50%
- Pond A-4 operating range: Minimum - 3.3 Mgal, 10%; Maximum - 21.1 Mgal, 65%
- Pond C-2 operating range: Minimum - 2.3 Mgal, 10%; Maximum - 14.7 Mgal, 65%
- Maximum drawdown rates for Ponds A-4, B-5, and C-2 are one foot per day
- Maximum drawdown rate for Pond A-3 is three feet per day
- Maintain current treatment systems at Ponds A-4 and C-2 in standby mode
- Pumps and transfer pipelines from Ponds B-5 and C-2 to Pond A-4
- Current network of real-time monitors for flow and water quality parameters upstream of the A-1 and B-1 Bypasses and on discharge pipe from Pond A-4. Real-time pond level monitors at Ponds A-4, B-5, and C-2. Real-time piezometer monitors at Pond B-5.
- Pre-discharge sampling continued at Pond A-4 except during controlled detention period
- 32- to 38-day discharge cycle
- 212 water quality parameters analyzed prior to release

Required Changes and Improvements

- Expansion of the real-time analytical network to monitor flow and water quality parameters on transfers from Pond B-5 or C-2 to Pond A-4, releases from Pond A-3 to Pond A-4, WWTP effluent, and discharges from Pond C-2 or Pond A-4.

This alternative closely matches current operations, with the exception that under this scenario discharges are allowed during high runoff periods after a shortened period of detention, particularly in the spring. Batch discharge operations and analytical monitoring are achievable the remainder of the year. This alternative relieves high spring pond volumes which have historically caused short circuiting of the batch discharge cycle well into the summer months.

6.2 EVALUATION CRITERIA

The following section describes the criteria and methodology used to screen and evaluate potential physical control measures for pond water management in more detail. Application and use of the statutory criteria from Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) are required by EPA in the selection of a final remedial action. Slightly modified criteria are recommended by EPA for evaluation of interim actions.

Six site-specific evaluation criteria were selected against which all alternatives have been evaluated. Five of the criteria were assigned weighting factors (either a 1 or a 2) to reflect the relative importance of each criteria. The sixth criterion, cost, received no weighting factor, reflecting its use as a secondary consideration to differentiate between substantially equal alternatives. Those criteria with a weighting factor of two were considered more important in overall pond water management.

Each alternative received a score of 1 to 5 for each of the five weighted criteria. A higher score indicated that the alternative came closer to fully achieving the intent of the evaluation criterion than a lower score. The summation of score times weighting factor for each of the six criteria yielded a total score for the alternative. Total scores were compared to determine a preliminary ranking of alternatives with higher total scores representing "better" pond management programs. Table 6-5 is an evaluation matrix which shows the results of the preliminary ranking process. The Preferred Alternative was selected as the best combination of the above considerations.

Although the evaluation criteria used in this document combine both statutory and site-specific requirements, additional criteria, guidance, or requirements may become pertinent to the evaluation of pond water management alternatives in the future. Similarly, concerns associated with surface water management may also change over time. However, until such changes occur, these evaluation criteria represent IM/IRA and surface water management concerns at the Site.

6.2.1 Statutory Criteria

Guidance on Preparing Superfund Decision Documents, by the EPA Office of Solid Waste and Emergency Response (OSWER), Directive 9355.3-02 (EPA 1990), and associated fact sheets describe nine criteria to be used in the analysis of alternatives for interim remedial actions. The nine criteria are composed of two threshold criteria, five primary balancing criteria, and two modifying criteria. These criteria, and the critical questions considered by regulatory reviewers in evaluating whether these criteria are met, are listed below.

Threshold Criteria

1. Overall Protection of Human Health and the Environment

   - Does the alternative provide adequate protection?
   - Are risks eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls to levels that are protective of human health and the environment?

2. Compliance with ARARs

   - Does the alternative meet all ARARs selected for and applicable to this document or, if appropriate, provide the grounds for invoking a waiver?

Primary Balancing Criteria

3. Long-Term Effectiveness and Permanence

   - Does the alternative maintain reliable protection of human health and the environment over time, after clean-up levels have been met?

4. Reduction of Pollutant Toxicity, Mobility, or Volume Through Treatment

   - What is the anticipated performance of the treatment technologies for each treatment alternative?

5. Short-Term Effectiveness

   - Does the alternative have any adverse impacts on human health and the environment during the construction and implementation period?

   - Can mitigation techniques minimize adverse effects?

   - What are the methods that will achieve protection, and how long will it be until protection is achieved?

6. Ability to Implement

   - Is the alternative technically and administratively feasible?

   - Are the services and materials available for a particular option?

7. Cost

   - What are the present worth, capital, and operation and maintenance (O&M) costs for the alternative?

Modifying Criteria

8. State/EPA and Natural Resource Trustee Acceptance

   - Are regulatory agency comments and concerns addressed?

   - Do the regulatory agencies accept the selected recommended remedy?

   Criterion 8 has been modified to specifically identify Natural Resource Trustees as a quasi-regulatory agency. EPA guidance on these nine criteria does not include Natural Resource Trustees as a regulatory agency, but the concerns of the Natural Resource Trustees are becoming increasingly important at this and other CERCLA sites.

9. Community Acceptance

   - Are the public's comments and concerns addressed?

6.2.2 Site-Specific Criteria

Site-specific criteria are applicable to pond water management and the goals and objectives of this document. Criteria associated with the defined scope, goals, and objectives of this document include:

1. Achieves Segment 4 Standards for Off-Site Discharges

   This site-specific criterion evaluates the ability of the alternative to ensure that water discharged from the pond system to downstream locations achieves Water Quality Control Commission (WQCC) water quality standards assigned to Segment 4 of Big Dry Creek, and derived concentration guides (DCGs) for radionuclides as identified by the DOE (Chapter 5). A weighting factor of 2 is assigned to this site-specific criterion primarily to reflect the correlation of this criterion to threshold criteria 1 and 2, primary balance criterion 8, and modifying criterion 9. These site-specific criteria represent the importance of protection of human health and aquatic life.

Segment 4 standards are pertinent to both of the Threshold Criteria defined by CERCLA. These standards have been selected in Chapter 5 of this document as potential ARARs for non-radionuclides. The WQCC adopted these standards for protection of human health and the environment. DCGs for radionuclides are risk-based standards which are also protective of human health, and are therefore appropriate water quality goals.

Segment 5 stream standards apply to waters within the A- and B-series drainage ponds. Source controls have been and continue to be developed to meet the water quality goals of Segment 5. Segment 5 stream standards are used as comparison criteria for water quality, and will help to define when upstream investigations of incoming pollutants will be necessary.

2. Ensure Protection of Ecosystems

This criterion evaluates the ability of each alternative to minimize stress on existing aquatic and terrestrial ecologies and comply with the Endangered Species Act (ESA), Fish and Wildlife Coordination Act, and other laws enacted to protect native populations and habitat. A formal Biological Assessment will be conducted to assess ecological impacts of the selected alternative(s).

At this time the site ecosystems are being studied and defined. It is known, however, that species which are potentially threatened or endangered do exist at the Site. Thus, the impacts from any change in pond operations will need to be carefully addressed. For the purposes of this evaluation, changes to the ecosystem were considered negative. Thus, the existing situation received the highest score.

A weighting factor of 2 is assigned to this criterion to reflect the fact that protection of the environment via compliance with ecologically-based environmental laws carries equal weight to protection of human health via water quality standards.

The ESA and other ecologically-based environmental laws which ensure protection of functional ecologies are identified in Chapter 5 as potential ARARs for pond water management. This site-specific criterion reflects both Threshold Criteria 1 and 2.

3. Maintain Safety and Security of Dam Structures

This criterion evaluates the ability of the alternative to maintain acceptable factors of dam safety against the retained volume of water and short-term and long-term residence time. The relative ranking for each alternative takes into consideration that higher retained volumes and longer residence times increase the relative risk to the dams. A weighting factor of 2 is assigned to this criterion to reflect the potential consequences from a partial or complete dam failure.

This site-specific criterion relates to Threshold Criteria 1 and 2 and Primary Balancing Criterion 3. Consideration of dam safety during pond water management operations is essential in reducing overall risks to downstream environments. In addition, dam safety requirements are central TBCs identified in Chapter 5. In addition, maintaining these structures in good condition provides reliable, long-term protection against contaminant releases during the life of clean-up operations at the Site.

4. Maximize Pond Capacity for Stormwater Collection

This criterion evaluates the ability of each alternative to capture, retain, and otherwise attenuate flow rates of off-site discharges of high volume storm events by minimizing the likelihood of spillway overflow conditions due to high initial (e.g., pre-storm event) storage volumes. The relative ranking takes into consideration the ability of Ponds A-3, A-4, B-5, and C-2 to retain the 100-year, 6-hour and 25-year, 6-hour storm events under the various management alternatives. A weighting factor of 1 is assigned to this criterion to reflect the low probability of large storm events. However, large storm events have the highest potential to transport potentially contaminated sediments and cause damage due to erosion and flooding.

This criterion relates to Threshold Criterion 1 and Primary Balancing Criteria 4 and 5. Controlling sediment transport is protective of human health and the environment, while controlling flood flows prevents short-term adverse impacts. Importantly, short-term retention of storm flows essentially treats stormwater through settling of suspended solids, thereby reducing sediment mobility and the quality of water discharged off-site.

5. Minimize Contaminant Migration

This criterion evaluates the ability of each alternative to identify and isolate waters containing elevated levels of environmental contaminants, minimize the affected volume of water requiring treatment, and minimize the potential spread of existing environmental contamination both on- and off-site. The relative scoring takes into consideration the desire to treat the existing contaminant as close to its source as possible, which will avoid the creation of additional or expanded IHSSs. Thus, this criterion addresses contaminant migration at the Site and in the ponds. Contaminant migration off-site is considered and addressed in Criterion 1. A weighting factor of 1 is assigned to this criterion to reflect the desire to avoid creating larger, more complex or additional clean-up sites and minimize long-term clean-up costs.

This criterion relates to Threshold Criterion 1 and Primary Balance Criterion 3. Minimizing contaminant migration through appropriate engineering and institutional controls provides effective long-term benefits to public health and the environment.

6. Minimize Capital and Operating Costs

This criterion evaluates the level of costs associated with implementing specific pond water management alternatives. No weighting factor is assigned to this criterion and no scoring of alternatives is assigned on the basis of cost. This criterion is used only as a secondary consideration to differentiate between alternatives which are substantially equal based on other evaluation criteria. This site-specific criterion is equivalent to Statutory Criterion 7.

It is important to recognize that these criteria conflict with each other in some cases. For example, controlled detention alternatives are best for dam-safety and storage-related issues but may not be effective in limiting contaminant migration or in meeting stream standards because the residence time of the water in the ponds is decreased.

There are many other criteria that could have been evaluated as a part of this project; however, it is beyond the scope of this document to address all potential evaluation criteria. Further evaluation of additional criteria identified in agency or public comments is appropriate prior to final IM/IRA action.

6.2.3 Hydrologic Aspects of Alternatives

The alternatives were evaluated from a hydrologic perspective to ascertain their potential effects on pond operations, the flow regime in Walnut Creek downstream of Pond A-4, and water level fluctuations in the ponds.

6.2.3.1 Hydrologic Aspects of Alternatives with Respect to Pond Operations

The effects of the various alternatives on the level of water in the ponds, transfer of water between the ponds, and release of water from Pond A-4 were analyzed through the development of a computer spreadsheet model. This computer spreadsheet is essentially a mass balance model that can be used to route inflow through the pond system under a variety of operating scenarios considered in the proposed alternatives. The model is based on the historic period of record of January 13, 1992 through June 30, 1994. There were no large (2-year storm events or greater) storm events during the period.

The data supplied as inflow and outflow to the model were not measured directly with the exception of pond discharges and transfers and WWTP effluent. Rather, the historic pond levels were used to calculate the daily change in storage volume within each of the ponds. These volumes correspond to the overall inflow less overall outflow from the ponds.

Each alternative defines operating criteria which govern the discharges from and transfers into the ponds. In order to simulate the operation of the ponds under each alternative, the effects of the historical pond discharges were removed from the pond level data. The influence of historical practices was removed by adding in pond discharges and subtracting out incoming transfers. The resulting data represented the inflows less evaporation losses from the ponds.

Under Alternative 0, water is routed through the ponds based on the general present operating criteria for the ponds. In general, these operating criteria are based on keeping the volume of water within the ponds above a prescribed minimum level and below a prescribed maximum level.

Under Alternative 1, the routing of water through the ponds is the same and the maximum levels in Ponds A-4 and B-5 at which releases begin was increased to take into account the additional allowable storage. In the evaluation of Alternative 2, the same operating criteria as Alternative 0 were used, but the overall volume of water was reduced because of increased consumptive use through spray evaporation. Likewise, in Alternative 3, the operating criteria were identical to Alternative 0, but the overall volume of water routed through the ponds was reduced because WWTP effluent was discharged directly to the stream.

The operating rules for Alternatives 4 and 5 are significantly different than the operating rules for Alternative 0 because they are controlled detention rather than batch alternatives. At high Pond A-4 levels, the treatment system operating at approximately 1.7 million gallons per day becomes the limiting factor governing the release rate. Alternatives 4 and 5 allow all water that flows into the ponds to be released at its maximum possible rate. The one exception is that after precipitation events of 0.5 inches or greater, water is held in Ponds B-5 and A-3 for a period of two days to allow for sedimentation.

Alternative 6 is essentially a hybrid of Alternatives 0 and 5. The operating rules for Alternative 0 are followed for the period June through February and the operating rules for Alternative 5 are followed for the period March through May.

6.2.3.2 Hydrologic Aspects of Alternatives with Respect to Timing of Releases and Pond Level Fluctuations

For Alternative 1, water will be released to Walnut Creek downstream of Pond A-4 for a 3- to 8-day period every 30 days. The normal release rate of 1 to 2 million gallons per day is increased to 2 to 5 million gallons per day. There are no planned releases between batching cycles. Pond levels increase during the storage portion of the batching cycle and then decrease during the release portion of the cycle, and, under this alternative, will fluctuate significantly.

For Alternative 2, water will be released to Walnut Creek downstream of Pond A-4 for a 7- to 10-day period every 35 days, and the total volume of water released will be reduced by 40 million gallons per year or more. This equates to consumption or non-generation of approximately 110,000 gallons per day. This will result in a reduced release volume of approximately 40 million gallons per year, which will significantly improve the ability to conduct batch discharges following analysis of the water. Typical batch discharges under this option will vary between 1 and 2 million gallons per day per batch discharge. There are no planned releases to Walnut Creek downstream of Pond A-4 between batching cycles. Pond levels will fluctuate under this scenario, increasing during the storage portion of the batching cycle and then decreasing during the release portion of the cycle. The fluctuations will be smaller than those experienced under the baseline scenario, Alternative 0.

Under Alternative 3, water will be released to Walnut Creek downstream of Pond A-4 at a constant rate of approximately 150,000 gallons per day (0.25 cfs), plus greater releases for a 7- to 10-day period every 35 days. The release rate during the batch release will be approximately between 1 and 2 million gallons per day (approximately 1.5 to 3.1 cfs). Pond levels will fluctuate under this alternative, but will be less variable than other batch release alternatives.

Under Alternative 4, there will be a continuous discharge averaging approximately 400,000 gallons per day (approximately 0.6 cfs) to Walnut Creek downstream of Pond A-4. Pond levels will fluctuate much less in this scenario than in any of the batch discharge alternatives and will be generally lower than other batch cycle alternatives. In this alternative, the ponds will be acting essentially as stilling basins, attenuating stormwater discharge surges.

The hydrologic regime in Walnut Creek downstream of Pond A-4 will be the same for Alternative 5 as Alternative 4. There will be a continuous discharge of approximately 400,000 gallons per day (approximately 0.6 cfs) released to Walnut Creek. The pond levels will fluctuate far less and they will be maintained at a lower level as compared to batch discharge alternatives.

In Alternative 6, water would be released to Walnut Creek downstream of Pond A-4 for a 7- to 10-day period every 35 days for approximately 9 months of the year. During the spring runoff (generally March, April, and May) water would be released on a continuous basis. Pond levels will fluctuate significantly during the portion of the year where a batching cycle is used. During the portion of the year where there is a controlled detention system, the pond levels will not fluctuate as greatly and they will be maintained at a relatively low level.

6.2.4 Scoring Scheme for the Various Management Alternatives

Numeric scoring of each alternative against individual evaluation criteria ranges from 1 (low) to 5 (high). In assigning a score to an individual alternative, increasing values represent increasing confidence that the specific criterion can be achieved, irrespective of the performance of other alternatives against the same criterion. In other words, more than one alternative can have the same score for a particular criterion, and some scores may not be represented by any of the alternatives.

In assigning scores, the following approach was used:

Score of 1: Evaluation indicates the criterion can probably be achieved less than 10 percent of the time, or for less than 10 percent of total discharge volume. Subjectively, this score reflects "poor" performance of the alternative against the criterion.

Score of 2: Evaluation indicates the criterion can probably be achieved approximately 25 percent of the time, or for 25 percent of total discharge volume. Subjectively, this score reflects "fair" performance of the alternative against the criterion.

Score of 3: Evaluation indicates the criterion can probably be achieved approximately 50 percent of the time, or for 50 percent of total discharge volume. Subjectively, this score reflects average, or "adequate" performance of the alternative against the criterion.

Score of 4: Evaluation indicates the criterion can probably be achieved approximately 75 percent of the time, or for 75 percent of total discharge volume. Subjectively, this score reflects "good" performance of the alternative against the criterion.

Score of 5: Evaluation indicates the criterion can probably be achieved greater than 90 percent of the time, or for greater than 90 percent of total discharge volume. Subjectively, this score reflects "superior" performance of the alternative against the criterion.

It should be recognized that the percentages used in these scores have uncertainties. In addition, these scores do not specifically account for seasonal variations which influence pond operations and water quality.

6.3 EVALUATION RESULTS

A quantitative evaluation of the management alternatives was used in scoring wherever possible. Criterion 2, ensure protection of ecosystems, and Criterion 5, minimize contaminant transport, could not be evaluated quantitatively. A subjective determination of poor, fair, good, better, or best was made in order to select scores for these two criteria.

Tables 6-1 through 6-6 present various analyses of the alternative management schemes based upon 900 days of actual data for the period January 13, 1992 through June 30, 1994. The actual data used in these analyses were the pond level measurements taken in the field, usually every third day, and converted to corresponding pond volumes. This data set was chosen over gaged inflow measurements due to the completeness of the record for the given period. The gages have significant gaps in the record due to mechanical problems and freezing. Additionally, the change in pond volumes reflects all of the sources of inflow and outflow from the ponds, including stormwater and baseflow, evaporation losses, and discharges/releases into or out of the ponds. Physical operating constraints, such as safe water levels in the ponds and maximum discharge and pond drawdown rates, were also incorporated into the analysis.

In Table 6-1, the alternative management operations were applied to the actual pond inflows as deduced from the pond volume measurements to determine when the ponds could and could not successfully batch discharge. The reasons for failing to batch discharge were also analyzed and the frequency with which each pond was responsible for a failed batch was quantified as part of this table.

Table 6-2 is a slightly different presentation of the same data and analyses presented in Table 6-1. Instead of simply presenting the number of successful batch discharges, Table 6-2 quantifies the volumes of water which were successfully batch tested prior to discharge.

Table 6-3 presents an analysis of the options versus the ability of the options to meet a dam safety factor of 1.5. This dam safety factor is an assumed value calculated by EG&G and based on the recent USACE report (USACE 1993). Current maximum safe pond levels are based on a calculated minimum dam safety factor of 1.2. As can be seen from a review of Table 6-3, even in the controlled detention and discharge options there are times when Pond A-4 does not meet the recommended dam safety factor of 1.5. The primary limiting factor that causes this dam safety concern is the maximum allowed discharge rate from Pond A-4.

Table 6-4 is an analysis of the ability of the various water management alternatives to capture major storm events. Pond A-3 and A-4 available capacities were combined and compared to the yield from the 25-year, 6-hour storm and the 100-year, 6-hour storm. Pond B-5 was evaluated based on the ability to capture the 10-year, 6-hour storm and the 25-year, 6-hour storm. Two return frequencies were evaluated because it allowed differentiation between the various water management alternatives.

Table 6-5 is an analysis of detention times within the WWTP for a typical WWTP influent flow. These detention times represent periods when a spill or a release can be detected and managed prior to release to the detention ponds or the downstream drainage.

Table 6-6 is an analysis of stormwater detention times within the ponds receiving stormwater. This analysis is based on an assumed inflow rate of 1.5 cfs. The 1.5 cfs was used as a conservative estimate of inflow from storms up to 0.50 inch in a 24-hour period. Runoff hydrographs from numerous storms, up to 0.75 inch, showed a maximum average flow rate of 1.1 cfs.

Table 6-7 is a tabulation of the scores of each alternative for each of the evaluation criteria.

6.3.1 Criterion 1 - Achieves Segment 4 Standards for Off-Site Discharges

One of the stated goals of the regulatory agencies is to have off-site discharges from the Site meet Segment 4 stream standards.

Scoring of alternatives versus the stated objective of criterion 1 is affected by the manner in which the criterion is interpreted. "Achieving Segment 4 Standards for Off-Site Discharges" can be interpreted in a variety of ways, two of which are listed below:

1. Water quality on discharge meets the imposed standards, or

2. Sampling and analytical programs demonstrate water meets standards <u>prior to</u> discharge, via pre-discharge sampling, regardless of whether physical factors such as dissolved oxygen, pH, or algal blooms degrade the water quality after pre-discharge sampling occurs.

This difference in interpretation is vital to scoring alternatives against this criterion because some alternatives that score very high using one interpretation, score very low using the other interpretation. For example, installing a multi-million dollar full-scale treatment system (e.g., Alternative 4) for continuous treatment would virtually guarantee discharge water quality will meet standards, but demonstrating water quality via analytical results prior to discharge is impossible at this time. In the future it may be possible to demonstrate water quality prior to discharge via real-time monitoring equipment, but at this time such equipment does not exist for all parameters of interest at the Site.

Evaluation of Criterion 1 centered on the ability of each alternative to truly meet the Segment 4 discharge requirements in off-site discharges. For approximately five years, the drainage ponds have been operated in a manner that approximates seasonally modified batch discharges. The goal during this five-year period has been to achieve batch discharge of the Site waters. Pond water samples have been collected prior to discharge and analyzed for approximately 212 chemical parameters. The water was released from the ponds if the data generated from the sampling indicated that the water quality met Segment 4 stream standards.

However, as discussed previously, approximately 18 days typically pass between collection of a pond water sample and receipt of the laboratory data. An additional 16 days typically passed in the various other administrative duties prior to actual release of the water. Thus, over 30 days typically elapse between collection of a pond water sample and the discharge of pond water. Even with no inflows of water to a pond, profound water quality changes can occur to waters held within one of the drainage ponds in a 30-day time period. These water quality changes can cause the discharged water to fail to meet Segment 4 water quality standards even if the pre-discharge sample had adequate quality. Thus, the pre-discharge sampling as has been practiced at the Site since approximately 1989, is a relatively poor predictor of actual water quality being discharged. Tables 6-1 and 6-2 present summary information on the ability of the various management alternatives to achieve batch discharges after monitoring.

From the perspective of stormwater management, batch discharge alternatives rank high because they allow potentially contaminated sediments to settle out of the water column. However, in the summer months, when chemical stratification of the ponds is greatest, these alternatives are less advantageous. Increased release of metals, radionuclides, and other contaminants from sediments during periods of chemical stratification is possible. For instance, it is believed that the detections of plutonium in Pond C-2 waters during warm months is partly due to stratification of waters in this pond.

Thus, for scoring alternatives, the current situation, Alternative 0, has been assigned a score of 3. However, decreased batching of water in the summer months, or decreased number of batch discharge cycles in the summer months, receive a score of 4. This slightly higher score is appropriate since it is anticipated that fewer water quality problems will be experienced if batch discharges in the summer are decreased.

Alternative 1 results in 88.4 percent of the flow volumes being monitored prior to discharge (Table 6-2). However, this alternative will result in increased batch discharge operations, including in the summer months. This alternative will generally result in faster drawdowns and shorter batch discharge cycles. Operations personnel will also be provided with additional flexibility for conducting general stormwater management. If operated properly, seasonal flow variations can be managed without increasing routine ambient pond levels and retained volumes on a long-term basis. Similarly, if poor quality water is identified in the ponds, the operational flexibility and retention capability for that water is increased. A score of 4 is assigned to this alternative since it will decrease the batch discharge cycle times, and since the ability to manage poor quality water will be increased.

Monitored flow volumes for Alternative 2 are approximately 65 percent (Table 6-2). The same water quality concerns related to the length of time between sample collection and water discharge apply to this alternative as discussed for Alternatives 0 and 1. However, the total volume of water batch discharged in the summer can be substantially reduced in this alternative. Therefore, Alternative 2 is scored as a 4.

For Alternative 3, WWTP flows make up approximately 56 percent of total discharge volume from the A- and B-series ponds. The WWTP flows would leave the Site without pre-discharge monitoring. However, influent to the WWTP will be monitored for spills and releases. Should a spill or release be known or suspected, the WWTP discharge will be redirected to the 500,000 gallons of new tankage, or to Ponds B-1 or B-2. Detention time within the WWTP for detection and management of a spill or release is approximately 31 hours under typical flow conditions (Table 6-5). WWTP discharges will be made under the terms of an NPDES permit. Since the intent of this document is to address waters influent to the ponds, WWTP discharges are not applicable to this analysis since they would be addressed by an NPDES permit. Of the remaining water, 76 percent of the flows would be successfully batched. Also, the volumes of water retained in the ponds and discharged during the summer months will be substantially decreased by rerouting of the WWTP flows around the ponds. Therefore, Alternative 3 is scored as a 4 for this criterion.

In Alternative 4, it is assumed that all flows are treated prior to discharge. It is also assumed that a treatment facility can be built sufficient to ensure that all treated discharges meet stream segment standards. However, it should be acknowledged that available water quality data indicate that much of the treated water would not have required treatment. Although the cost of treatment plant construction and ongoing treatment are estimated to be significant, and there is generally no technical need for treatment, Alternative 4 scores a 5 for this criterion.

A critical issue in analysis of Alternative 5 is whether stormwater sediments will be removed from stormwater flows prior to discharge from the ponds. Pond detention times, operating the ponds at 10 percent volume, are approximately 110 hours in Ponds A-3 and A-4, and approximately 60 hours in Ponds B-4 and B-5 (Table 6-6). Thus, detention times for typical storms (of less than 0.5 inch in 24 hours) are adequate to allow for sediment removal. For any storm greater than 0.5 inch in a 24-hour period, a 48-hour no-discharge period is specified. This no-discharge period, when combined with pond detention times, will allow for sediment removal. Thus, although careful monitoring of the water quality under this alternative would be necessary, it is expected that the water quality exiting Ponds A-4 and B-5 would meet applicable stream segment standards under Alternative 5. However, it must also be acknowledged that currently available real-time monitoring equipment are not adequate to allow for verification that all flows meet the stream segment standards as they are discharged. For these reasons this alternative is given a score of 4.

In Alternative 6, a combination of batch discharges and controlled detention discharges are anticipated. During periods of the year when batching is possible, essentially all flows will be batch discharged. The score for this option during those time periods would be a 3. However, during some periods of the year, the water will be discharged via controlled detention (i.e., detention of storms greater than 0.5 inch and reliance on the inherent system detention times for other flows). For these time periods, the score would be a 4. Balancing these flow variations is difficult, but overall this option scored a 4 because of its similarity to the existing situation, and because the volumes that are batch discharged are done so in the summer when water quality concerns due to stratification are greatest.

6.3.2 Criterion 2 - Ensure Protection of Ecosystem Functions

Since a determination has not been made on the current ecosystem's requirements, nor on the desired natural resource management strategy, subjective evaluation of alternatives based on improvement or degradation of the ecology cannot be made. Rather, the argument must be made that any change to the current pond water management system will subsequently effect ecosystem functions. While change is not evaluated as good or bad, it is a change nonetheless. Until data become available (i.e., critical habitat for threatened and endangered species and information on ecosystem functions) that change the requirements of water management, system *status quo* will remain the basic premise for evaluating this criteria.

Based on the logic presented above, the alternative with the least changes to the current system receives the highest score. The alternatives judged to produce the most change to the current flow regime would therefore receive the lowest scores.

Alternative 0, by definition, receives the highest score of 5. No action means no change to the current system.

Alternative 6 receives a score of 4. Seasonally adjusted controlled detention and discharge with batch discharging when possible is most closely related to current operations. However, this alternative does propose some changes to current operations. These changes, regardless of how slight they may be, are assumed to alter the current ecosystem function.

Alternative 5 received a score of 3 that is appropriately lower than Alternative 6 because there is an even greater change to the current system. The score may have been even lower except this alternative maintains the detention of stormwater with the potential for batching of water that does not meet discharge requirements.

Alternatives 1, 3, and 4 all receive a score of 2. Alternative 1 may appear to be similar to current operations; however, there are two fatal flaws. First, construction of a new dam will destroy some portion of the riparian corridor. Critical habitat for Preble's Meadow Jumping Mouse has not been determined. Any loss of potential habitat, therefore, must be considered a major change to the current ecosystem function. Secondly, larger batches will produce even larger fluctuations in the terminal pond water levels that currently occur and will further alter the flow regimes down stream.

Alternative 3 is much like Alternative 5 when considering the flow regimes that will be managed. However, discharge of WWTP effluent directly into Walnut Creek will have a major impact to the current aquatic ecology due to increased nutrient loading of the stream. This would be accentuated during dry periods when stormwater flows would not be available to dilute the effluent. Therefore, this alternative will potentially produce a greater change to the current ecosystems.

Alternative 4 is also a significant departure from current operations. Routing all discharges through a treatment facility would produce a steady discharge rate throughout the year and water with a very low nutrient and mineral loading. These are significant changes from the current operational system, and thus Alternative 4 receives a score of 2.

Alternative 2 received the lowest score of 1. Major consumption of water on-site would dramatically alter the riparian ecology and other terrestrial ecosystems. This change would immediately affect off-site threatened and endangered species.

A more complete discussion of the ecosystems and an ecosystem assessment of impacts from the various alternatives is presented in Appendix A. Similarly, a section which meets the substantive requirements of a National Environmental Policy Act (NEPA) assessment is presented in Appendix B.

6.3.3 Criterion 3 - Maintain Safety and Security of Dam Structures

This criterion was evaluated by determining the hydraulic loading imposed on the terminal dams (e.g., pond levels) for each alternative against estimated dam safety factors.

The hydrologic model for batch discharge used in this evaluation and represented by Table 6-1 does not allow any of the alternatives to exceed maximum safe storage volumes. Instead, the model assumes an unmonitored release of water as the "failure mode" for potentially unsafe storage volumes. As previously noted, this mode of operation conflicts to some extent with Criteria 1 and 5. Maximum storage volumes correspond to a dam safety factor of 1.2, which represents minimum safety factors normally specified by state and federal dam safety officials for non-routine conditions (USACE 1993). In accordance with established dam safety criteria, minimum routine, long-term safety factors should not fall below 1.5. Scores of the alternatives against this evaluation criterion represent the number of times when the dam safety factors are above the normal design safety factor of 1.5. Table 6-3 presents the results of these calculations. The evaluation resulted in lower success ratios for Pond A-4. Thus, the discussion and scores are based on this pond since it is more limiting.

Batch discharge alternatives (0, 2, 3, and 6) routinely result in safety factors below 1.5, with varying frequencies; however, none of these alternatives did so greater than 25 percent of the time. Thus, all alternatives received scores of 4 or 5 for this criterion. Alternative 0 (no action) met the 1.5 factor of safety 76 percent of the time and received a corresponding score of 4. Alternatives 3 and 6 met the safety factor 88 and 86 percent of the time, respectively. Alternatives 3 and 6 both received a score of 4. Alternative 2 performed better, meeting the 1.5 safety factor 91 percent of the time. Alternative 2 received a score of 5 on this criterion. Alternatives 4 and 5, as controlled detention and discharge alternatives, are the most protective of dam safety and, as expected, received scores of 5. Controlled detention operations did violate the 1.5 safety factor at Pond A-4 on occasion but overall both alternatives met the dam safety factor 99 percent of the time. Alternative 1 also received a score of 5 under the assumption that improvements resulting is long-term storage capacities of 80 percent by definition means that the 1.5 safety factors are achieved.

6.3.4 Criterion 4 - Maximize Pond Volume Capacity for Stormwater Collection

This criterion evaluates total available pond capacity over time within the A-series (Ponds A-3 and A-4) and B-series (Ponds B-4 and B-5) drainages for each of the alternatives. The storage capacity of the interior ponds (A-1, A-2, B-1, B-2) is not evaluated.

Available stormwater storage capacity is a function of both allowable storage volume based on dam safety considerations, and the mode of releases from the ponds. To determine the numerical score of the alternatives for this criterion, the evaluation process considered the combined available capacities of Ponds A-3 and A-4, and the available capacity of Pond B-5. Ponds B-3 and B-4 were not evaluated because they are expected to continue operation essentially as flow-through ponds. Thus, these ponds provide for detention, but not storage, of stormwater. These capacities were separately evaluated with regard to the ability to handle large magnitude storm events for the respective basins draining to the ponds. The storm events analyzed correspond to the 6-hour, 100-year, 25-year, and 10-year events. Calculated percentages of the time that the ponds can capture the various storms are presented in Table 6-4. The evaluation resulted in lower success ratios for Pond B-5. Thus, the discussion and scores are based on this pond since it is more limiting.

All batch discharge alternatives did not perform well for this evaluation criterion. The reason for this performance was the limited ability of Pond B-5 to capture significant storm events. In order for Pond B-5 to contain the 6-hour, 10-year storm, the water level in Pond B-5 must be below 17 percent. The nature of batch operations do not allow Pond B-5 to maintain low pond levels, even when volumes are removed due to consumptive use or alternative WWTP discharge. Therefore, in accordance with the success ratios for Pond B-5 in Table 6-4, Alternatives 0 and 2 receive a score of 2. Alternatives 3 and 6 receive scores of 3.

Alternative 1 substantially increases potential available capacity to capture stormwater by increasing the maximum safe storage allowable in Ponds A-4 and B-5. The improvements to Pond B-5 have a dramatic effect on the ability to capture storms. Not only is Pond B-5 able to hold the 6-hour, 10-year storm over 90 percent of the time, it is also able to capture the 6-hour, 25-year storm event 85 percent of the time. This latter ability distinguishes Alternative 1 from all other alternatives. The score given to Alternative 1 is a 5 on the ability of the A- and B-series ponds to capture large storm events.

Alternatives 4 and 5 scored well as expected by their operating criteria, namely, maintain pond levels near 10 percent while routing all flows except those associated with precipitation events of 0.5 inch or greater. These alternatives are designed to manage the ponds such that they are best prepared to capture large storm events. The controlled detention alternatives are the best operational alternative for this criterion. Only strengthening the dams provides better overall ability to capture large storm events. However, because Pond B-5 cannot capture the 6-hour, 25-year storm event, Alternatives 4 and 5 receive scores of 4.

6.3.5 Criterion 5 - Minimize Contaminant Migration

This criterion evaluates the ability of each alternative to minimize transport of environmental contaminants to downstream users or transport between ponds. This criterion assumes that gross contamination events will be known, or can be detected, by upstream real-time monitoring equipment. These gross contamination events will be captured before being discharged. Evaluation of alternatives against this criterion must consider the potential source of contaminants, including spills carried by stormwater, stream baseflows, upsets at existing OU or WWTP treatment facilities, and remobilization of contaminated sediments.

Similar to the evaluation of Criterion 2, a quantitative evaluation of the alternatives using this criterion is unachievable. Subjectively, this criterion evaluates the alternatives on the basis of their ability to detect and capture contaminated stormwater or other flows and to minimize the volume of water potentially requiring treatment.

All of the batch discharge alternatives (0, 1, 2, and 3) capture contaminants before they reach Pond A-4. Alternative 0 (current conditions) was selected as representative of average performance for this criterion. Other alternatives were evaluated against current conditions. Alternative 3 scores higher than average due to the reduced water volumes retained under this alternative. Retained water volumes are reduced due to the direct off-site discharge of WWTP effluent. Arguments could be made that a greater risk of contaminant migration is associated with this alternative due to the direct off-site discharge of WWTP water. However, the WWTP discharges will be made under the terms of an NPDES permit and it is assumed that these discharges will comply with the permit. Therefore, WWTP discharges do not influence the scoring in this document. The Alternative 3 score for this criterion is 4.

Alternative 1 increases routine retained volumes which will also increase potential treatment volumes. This alternative scores lower than the average batch discharge alternative.

Alternative 2 also scores lower than average. This alternative will reduce potential volumes requiring treatment, but has a high potential to spread rather than minimize contaminant migration in some consumptive use scenarios (such as spray irrigation) if contaminants are not detected.

Alternatives 4 and 5 scored less than the average because of the controlled detention and discharge mode of operation. Even though Alternative 4 provides continuous treatment, which will minimize downstream migration of contaminants, migration of contaminants to Pond A-4 would be allowed and is less protective than current conditions. Alternative 4 received a score of 2. Alternative 5 provides upstream real-time monitoring, which is capable of detecting "slugs" of contaminants, but current technology cannot monitor for low levels of contaminants, particularly radionuclides. These contaminants could move to Pond A-4 and downstream locations. Therefore, Alternative 5 received a score of 2.

Alternative 6 was evaluated as average, and received a score of 3. Although Alternative 6 includes a controlled detention and discharge period during which contaminants can potentially migrate downstream, this only occurs during peak runoff or flow conditions. During these conditions, potential concentrations of contaminants in discharges may be reduced by dilution volume. This consideration would tend to improve the score to one better than 3. However, sediments may be transported in these peak runoff conditions, and so the total mass of contaminants transported could increase. These two considerations offset each other, resulting in a score of 3.

6.4 ALTERNATIVES SUMMARY

The preceding evaluation of alternatives focused on criteria representative of specific operational considerations important to overall pond water management. Interpretation of the results of this evaluation requires consideration of both the positive and negative aspects of individual alternatives prior to selecting a preferred alternative. No alternative was clearly preferred for all criteria. Each alternative scored high in some areas and low in others.

Table 6-7 presents a summary analysis of the various pond water management alternatives. Higher total scores represent more desirable options for overall water management. Based on the total scores for the various water management alternatives, Alternative 4 and 5 were tied for the highest score with a score of 30. In order to chose between the highest scoring options, a cost estimate was conducted for these two options. Although cost is not to be considered a driver for selection of options, it is used in this context to compare equally scored options. This cost estimate indicates that Alternative 5 is the chosen water management alternative due to the much lower costs associated with implementation of this alternative.

However, although Alternative 5 is the chosen water management alternative, certain aspects of the other high scoring alternatives should be evaluated. For example, examination of Table 6-7 indicates that Alternative 4 scored higher than Alternative 5 for Criterion 1, achieving Segment 4 stream standards in offsite discharges. The reason that Alternative 4 scored higher for this criterion is because a treatment system would be engineered and would be used to treat flows prior to offsite discharge. It was assumed that there is technology available to treat to the levels necessary to meet Segment 4 stream standards in offsite discharges. Although the water quality data do not indicate a significant water quality problem, the operational flexibility offered from the availability of a treatment plant is desirable. Thus, it appears prudent to study and evaluate the various treatment means that might be used at Pond A-4 to treat waters to Segment 4 stream standards.

With regard to the next highest scoring alternatives, Alternatives 0 and 1 were both tied with a score of 29. A cost analysis indicates that Alternative 0, the no additional action alternative, is more desirable from a cost point of view since no new facilities are required. This consideration, along with the consideration of the chosen alternative, indicates that no aspects of Alternative 1 should be implemented. Alternative 1 scored higher than Alternative 0 only for criteria 3 and 4. These higher scores were due to the greater ability of Alternative 1 to achieve true batch discharges because of dam modifications. However, since the chosen alternative generally meets dam safety requirements, and the cost of dam modification is high, it is recommended that no dam modification work be conducted at this time.

In order to allow for the transition from the current type of batch operations to the controlled detention and discharge operations recommended in Alternative 5, it is recommended that a series of successive implementation steps be taken. These implementation steps will successively move toward increased controlled detention operations, while generating and analyzing data in order to ensure that the stated performance criteria are met by the chosen alternative. One area of need is a study of potential treatment methods for upgrading the Pond A-4 treatment system. Another area of need is generation and analysis of water quality and water quantity data supportive of the chosen alternative. Thus, real-time monitoring already ongoing will be expanded and upgraded, and the data generated from these real-time stations will be analyzed along with the data generated from increased water quality monitoring activities. Chapter 7 presents an implementation plan for the gradual transition from the current batch discharge operational mode to the modified controlled detention and discharge operational mode.

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No figures included for Chapter 6

TABLE 6-1
POTENTIAL SUCCESS OF BATCH MODE OPERATIONS[1]

Alternative	Number of Batch Cycles	Number of Successful Batches	% of Successful Batches	Number of Failed Batches due to:[2]		
				Pond A-3 > 90% of Capacity	Pond A-4 > 65% of Capacity	Pond B-5 > 50% of Capacity
Historic[3]	16	3	19	2	0	13
0[4]	24	14	58	2	4	7
1[5]	32	31	97	1	1	0
2[6]	27	24	89	2	2	2
3[7]	28	26	93	1	2	1
4[8]	N/A	N/A	N/A	No Dam Safety Levels Exceeded		
5[9]	N/A	N/A	N/A	No Dam Safety Levels Exceeded		
6[10]	16	14	88	0	0	2

(1) A successful batch is considered to be a complete batch cycle occurring without exceedance of dam safety levels or concurrent discharges of B-5 and/or A-3 with A-4.

(2) A failed batch occurs when any one of the following happens:

1. Any of the dam safety levels are exceeded.
2. B-5 and/or A-3 discharge concurrent with A-4 discharge.
3. The 18-day testing period is shortened due to dam safety levels forcing early pond releases.

(3) Reflects actual pond management over the time period 1/13/92 to 6/30/94.

(4) No Action Alternative: Reflects actual flows with releases from ponds according to strict criteria.
Ponds will release before exceeding dam safety levels.
Ponds will release down to 10%, unless another pond approaches dam safety level.
B-5 always releases at maximum rate; A-3 release rate dictated by its level and A-4's proximity to dam safety level; A-4 always releases at maximum rate.

(5) Continued Batch Discharge with Phased-In Pond Capacity Increases: A-4 and B-5 dam safety levels are increased to 80% of capacity. Operating criteria analogous to Alternative 0.

(6) Continued Batch Discharge with Phased-In Water Consumption: 40 Mgal per year consumed from B-5 distributed evenly throughout the year. Operating criteria same as Alternative 0.

(7) Continued Batch Discharge with Phased-In Direct Discharge of WWTP: Operating criteria same as Alternative 0.

(8) Continuous Treated Discharge with Phased-In Treatment Upgrades: Hold storms greater than or equal to 0.5 inches per day for 2 days in Ponds A-3 and B-5. Maintain ponds at 10% minimum.

(9) Controlled Detention and Discharge with Phased-In Real-Time Monitoring: Hold storms greater than or equal to 0.5 inches per day for 2 days in Ponds A-3 and B-5. Maintain ponds at 10% minimum.

(10) Seasonally Adjusted Controlled Detention and Discharge /Batch Discharge: Controlled detention and discharge period is March through May. Same operating criteria as Alternative 0 during batch and Alternative 5 criteria during controlled detention and discharge.

TABLE 6-2
SUCCESS RATIOS OF ALTERNATIVES FOR BATCH DISCHARGE OPERATIONS

Alternative	% of Total Volume[1] Released With Complete Pre-Discharge Analytical Results
0[2]	63.5
1[2]	88.4
2[2]	67.7
3[3]	76.0
4[4]	0
5[4]	0
6[5]	40.5

[1] Total Discharge Volume ≈ 360 million gallons over 900-day period (1/13/92 to 6/30/94).
[2] Volumes released include early transfers from A-3 and B-5 during failed batches.
[3] Volumes released include early transfers from A-3 and B-5 during failed batches.
[4] Controlled detention and discharge alternatives do not receive analytical results before discharging.
[5] Volumes released include early transfers from A-3 and B-5 during failed batches and discharges occurring during controlled detention and discharge periods.

901-004\45A-jmk\Tab6-2&3

TABLE 6-3
SUCCESS RATIOS OF ALTERNATIVES IN ACHIEVING DAM SAFETY

Alternative	Days Meeting Dam Safety Factor of 1.5[1]			
	Pond A-4 (<52%)[2]		Pond B-5 (<40%)[3]	
0	680	(75.6%)	733	(81.4%)
1[4]	900	(100 %)	900	(100 %)
2	815	(90.6%)	834	(92.7%)
3	792	(88.0%)	868	(96.4%)
4	892	(99.1 %)	900	(100 %)
5	898	(99.8%)	900	(100 %)
6	770	(85.6%)	855	(95.0%)

(1) Total number of days of record = 900.
(2) Pond A-4 maximum safe level of 65% corresponds to an assumed dam safety factor of 1.2, increasing the dam safety factor to 1.5 reduces the maximum safe level to 52% of capacity.
(3) Pond B-5 maximum safe level of 50% corresponds to an assumed dam safety factor of 1.2, increasing the dam safety factor to 1.5 reduces the maximum safe level to 40% of capacity.
(4) Dam improvements designed for 1.5 safety factor for long-term storage.

TABLE 6-4
SUCCESS RATIOS OF ALTERNATIVES FOR HOLDING LARGE STORM EVENTS

Alternative	% of Time A- and B-Series Ponds Can Hold Large Magnitude Storms Without Release[1]			
	Ponds A-3 & A-4[2]		Pond B-5[3]	
	25-yr, 6-hr[4]	100-yr, 6-hr[5]	10-yr, 6-hr[6]	25-yr, 6-hr[7]
0	94.6	52.4	17.1	0
1[8]	94.3	79.9	92.6	85.1
2	98.4	70.7	38.2	3.6
3	93.2	72.3	51.2	4.7
4	100	97.6	92.3	5.7
5	100	98.0	92.3	5.7
6	96.6	73.8	46.3	1.6

(1) Maximim safe levels are: A-3 - 90%, A-4 - 65%, B-5 - 50%.
(2) A-3 and A-4 combined have a maximum safe capacity of 32.3 Mgal.
(3) B-5 has a maximum safe capacity of 12.0 Mgal.
(4) A-Series: 25-year, 6-hour event yields 10.30 million gallons.
(5) A-Series: 100-year, 6-hour event yields 16.94 million gallons.
(6) B-Series: 10-year, 6-hour event yields 8.05 million gallons.
(7) B-Series: 25-year, 6-hour event yields 9.81 million gallons.
(8) Maximim safe levels are: A-3 - 90%, A-4 - 80%, B-5 - 80%, Alternative 1 only.

TABLE 6-5
TIME ESTIMATE OF CONTAMINANT TRAVEL THROUGH WWTP
(Flow rate 100.00 gpm)

	Minutes	Hours
Arrival at 995 Headworks	0.00	--
Arrival at #1A-Basin	127.66	2.13
Arrival at #1 Secondary	601.59	10.03
Arrival at Tertiary Clarifier	1003.71	16.73
Arrival at Sand Filters	1766.55	29.44
Arrival at Chlorine Contact	1848.55	30.81
Arrival at Outfall	1881.01	31.35

TABLE 6-6
APPROXIMATE DETENTION TIMES IN STORMWATER PONDS

Operating Condition (% Full)	A-Series Ponds				B-Series Ponds			
	Pond	Volume (million gallons)	Detention Time (hours)	Total Detention Time (hours)	Pond	Volume (million gallons)	Detention Time (hours)	Total Detention Time (hours)
10	A-3	1.24	31	111	B-4	0.018	0.4	60
	A-4	3.25	80		B-5	2.40	60	
50	A-3	6.20	154	555	B-4	0.09	2	299
	A-4	16.25	402		B-5	12.0	297	

Notes: Detention time computed as follows:

$$\text{time} = \frac{\text{operating pond volume}}{\text{average flow rate}}$$

The assumed maximum average flow rate is 1.5 cfs, to conservatively represent runoff from storms up to 0.5 inch in 24 hours. The EG&G Surface Water group has analyzed runoff hydrographs at gages GS10 and GS13 for numerous storms up to 0.75 inch in 24 hours. The maximum average flow rate for all storms observed is 1.1 cfs. 1.5 cfs represents a conservative maximum average flow rate.

Discharges from the ponds will be stopped for 48 hours when greater than 0.5 inch of precipitation is received in a 24-hour period. The above table does not include this 48-hour detention time.

TABLE 6-7
EVALUATION MATRIX

Alternative	Evaluation Criteria*					Total Score	Cost†	
	1.	2.	3.	4.	5.		Capital	O&M††
Weight Factor:	2	2	2	1	1			
0 - Continued Batch Discharge - No Action Alternative	3	5	4	2	3	29	$ 0	$ 0
1 - Continued Batch Discharge with Phased-In Pond Capacity Increases	4	2	5	5	2	29	$1,500,000	$ 0
2 - Continued Batch Discharge with Phased-In Water Consumption	4	1	5	2	2	24	N/A†††	N/A
3 - Continued Batch Discharge with Phased-In Direct Discharge of WWTP Effluent	4	2	4	3	4	27	N/A	N/A
4 - Continuous Treated Discharge with Phased-In Treatment Upgrades	5	2	5	4	2	30	Approx. $10,000,000	Approx. $1,800,000
5 - Controlled Detention Discharge with Phased-In Real-Time Monitoring	4	3	5	4	2	30	Approx. $200,000	Approx. $20,000
6 - Seasonally Adjusted Controlled Detention and Discharge/Batch Discharge	3	4	4	2	3	28	N/A	N/A

*Evaluation Criteria:
1. Achieve Segment 4 standards for off-site discharges
2. Ensure protection of ecosystem functions
3. Maintain safety and security of dam structures
4. Maximize pond capacity for stormwater collection
5. Minimize contaminant migration

† Costs were only estimated for alternatives that received essentially equivalent total scores indicating that they could perform equally well. These orders of magnitude cost estimates are based on construction of facilities in uncontaminated areas. Actual cost of construction for all alternatives will probably be higher than estimated, but relative differences are expected to remain unchanged.

†† O&M costs were estimated for required changes and improvements, not existing alternative components.

††† N/A = Not Applicable.

Explanation: Scores of up to 5 are possible. A score of 5 indicates that the criterion can be achieved greater than 90 percent of the time, or for greater than 90 percent of the total discharge volumes. Sections 6.2.4 and 6.3 of this document present additional explanation of the table.

CHAPTER 7

IMPLEMENTATION PLAN

This chapter describes the proposed Interim Measures/Interim Remedial Action (IM/IRA) implementation plan for pond water management. A summary of proposed studies, physical controls and other activities, and the proposed schedule for implementation of these activities is given in Table 7-5. Decision trees (e.g., operational flow charts) that apply to water sources and individual ponds are given in Figures 7-1 through 7-8.

By definition, an IM/IRA is an expedited response action or correction action, generally of short term, done in accordance with remedial action authorities to abate an actual or potential threat to public health, welfare, or the environment at or from the Rocky Flats Environmental Technology Site (the Site). IM/IRAs usually are in place for two to three years, until Records of Decision (RODs) are completed, and final remedial actions commence.

Due to the uncertainty of the final remedial schedules for Operable Units (OUs) 5 and 6, this IM/IRA could possibly be in effect until final cleanup of the Site is completed, which is currently expected to take up to 20 years. Additionally, completion of Option B, as described in Chapter 2, must be considered before full implementation of the controlled detention and discharge mode of operation occurs. Therefore, implementation activities specified in this document are assumed to take place up to five years after this IM/IRA goes into effect, and long-term management will continue until final remediation occurs.

The proposed implementation plan for this IM/IRA can be briefly summarized as follows: Current batch mode transfer and discharge operations, associated pre-discharge sampling, and other current operational protocols will continue in the short-term. During Pond A-4 discharges, concurrent transfers of water from Ponds A-3 and B-5 will be conducted in response to storm events. Real-time water quality monitoring capabilities on upstream water sources will be implemented and evaluated against analytical results from other monitoring programs to determine correlations and predictive indicators. Expanded water treatment capabilities will be investigated and implemented. As these improvements are implemented and proven, routine operations will transition to a controlled detention mode for all transfers and discharges. Specific protocols will be defined for reverting to batch mode operations in response to abnormal events.

Water rights and ecological considerations must be addressed in order to implement the proposed (selected) water management alternative. Additional studies are necessary to determine the impacts of implementing the selected alternative, and to define mitigation measures to minimize those impacts. The following sections discuss pertinent water rights and ecological issues, and proposed study plans.

This chapter also discusses the monitoring plan proposed for implementation; corresponding decision criteria, procedures, and proposed operational protocols for routine, non-routine, and emergency operations; implementation activities for proposed facility upgrades, including associated studies; and a proposed implementation schedule.

Implementation activities and schedules are subject to document approval, as well as to the effective date of the new National Pollutant Discharge Elimination System (NPDES) permit, and to budget constraints. Full implementation of the proposed controlled detention and discharge mode of operations will also be dependent on submittal of technical memoranda and corresponding acceptence by the agencies. Thus, the proposed implementation schedule is given in terms of elapsed time from document approval rather than by specific calendar dates.

7.1 WATER RIGHTS ASSESSMENT OF SELECTED ALTERNATIVE

The water rights assessment of Alternative 5 takes into consideration downstream vested water rights, the Denver Water Department (DWD) supply, and potential requirements of the U.S. Fish and Wildlife Service (FWS). The following discussion represents an engineering interpretation of water rights issues and has not been reviewed by an attorney. Legal and technical water rights implications will be more fully investigated after final approval of the selected alternative.

7.1.1 Background

DWD furnishes foreign (trans-mountain) water to the Site which is fully consumable without injury to downstream water rights. Release of the unconsumed portion of this trans-mountain water from the Site adds to the native water supply in the South Platte River basin. DWD has asserted its claim to continuing dominion over this unconsumed portion, or "return" flow, from the water it delivers to the Site. Such water would be suitable to offset or replace future depletions of native water within the South Platte River basin.

The effluent from the wastewater treatment plant (WWTP) at the Site consists of imported water, which is routed through Ponds B-3, B-4, B-5, and A-4 prior to its final release to Walnut Creek. These four ponds and the other 8 detention ponds at the Site also, as a group, intercept naturally-occurring tributary water, a portion of which evaporates from the surfaces of the ponds. Under the pond management criteria of Alternative 5, on an annual basis, the return flows from the Sites' use of imported water would be approximately 5 times as great as the evaporative depletions to native water. A comparison of the monthly depletions and additions is presented in Tables 7-1, 7-2, and 7-3 for the period January 1992 through June 1994.

The subject detention ponds, where foreign and tributary waters are commingled for management purposes, are an integral part of the operations at the Site to fully meet regulatory requirements prior to discharge. For purposes of water administration, the discharge point of Site water use is measured at the boundary of the federal property; i.e., Indiana Street. Historically, Walnut Creek and Woman Creek at Indiana Street, together with the point of diversion for the Mower Ditch, have been the designated measuring points for any state administration and the Plant operator's water management.

The current regime of Walnut and Woman Creek is characterized by detention storage in the ponds and batch releases to the Broomfield Diversion Ditch, generally on a monthly basis (earlier it was on a continuous basis). Historically, Walnut Creek flow at Indiana Street was intercepted, stored in Great Western Reservoir, and used by the City of Broomfield. Flows intercepted from the Site and conveyed to the C-series ponds were previously batch released to Woman Creek which flows into Standley Lake for storage and use, but water in Pond C-2 is currently pumped to the Broomfield Diversion Ditch, which discharges to Walnut Creek below Great Western Reservoir. Historically, flow from the Site was not directly available to the owners of water rights downstream of Great Western Reservoir or Standley Lake.

7.1.2 Denver Water Department Supply

A contract for the sale of up to 1.5 million gallons per day (MGD), or approximately 140 acre-feet per month of raw water from the Denver Water Board to Dow Chemical Company "for the operation of said Rocky Flats Plant" was executed on October 28, 1952. The contract does not specifically address or quantify return flow obligations, but it does provide that "no water furnished under this contract shall be used for any purpose not immediately connected with the operation of the above mentioned Rocky Flats Plant without the express written permission of the Board." The contract was subsequently assigned by Dow Chemical to Rockwell International. The contract remains in effect between DWD and the present operator of the Site, EG&G.

A letter from DWD to Rockwell International, dated November 20, 1978, refers to the 1952 contract and states, "The (Denver Water) Department retains dominion over all water leased to Rockwell and after the first use by Rockwell, said water must return to the South Platte Drainage Basin."

7.1.3 Downstream Vested Water Rights Considerations

Under Colorado state law, water from natural tributary sources may be appropriated for beneficial use and such water can be "called" when needed in accordance with established priorities. Table 7-4 lists water rights on Walnut, Woman, and Big Dry Creeks.

With respect to pond water management at the Site, water rights considerations arise primarily from depletions caused by detention activities aimed at achieving water quality monitoring prior to discharge. When the Site intercepts and detains naturally-occurring tributary water, it is in the position of a junior appropriator.

7.1.4 Endangered Species Requirements

A special category of water rights considerations, which may have a bearing upon the evaluation of pond water management alternatives, are regulatory requirements which may be imposed for the purpose of enhancing levels of streamflow at the Nebraska state line for the protection of endangered species.

The South Platte River at the Nebraska state line has not historically had the benefit of the flow from the Site, as measured at Indiana Street, due to interception by Great Western Reservoir and Standley Lake. After the final remediation of OUs 5, 6, and 7 is achieved, it is anticipated that water management activities will result in a streamflow regime parallel to, or better than, that which existed prior to the opening of the facility in 1952; however, this consideration is beyond the scope of this interim report.

Even though the naturally occurring tributary flow of Walnut Creek at Indiana Street represents a nearly imperceptible portion of the flow at the state line, the *de minimis* factors have not been considered, but instead the principle involved with maintenance of state line flows is accepted for purposes of this interim report. The Sites' effective contribution to state-line interim period will be equal to or greater than those which have occurred since the construction of Great Western Reservoir in 1918. If it is determined that implementation of the selected alternative will result in depletions to the South Platte River basin which must be replaced, DOE will pursue sources of augmentation water in accordance with state law.

7.1.5 Quantification of Depletions and Additions

7.1.5.1 Evaporative Depletions

Table 7-1 presents calculated monthly evaporative depletions of naturally-occurring tributary water at the Site for the 30-month study period, January 1992 to June 1994, under the pond management criteria modeled for Alternative 5. Such depletions amount to approximately 32 acre-feet per year and would be expected to remain fairly constant while the ponds are in existence and serving as an integral part of operations.

7.1.5.2 Discharge of Imported Water

Table 7-2 presents calculated monthly quantities of foreign water discharged from Pond A-4 under the pond management criteria modeled for Alternative 5. The net releases of imported water amount to approximately 150 acre-feet per year after accounting for a proportional share of the pond evaporation.

7.1.5.3 Balance of Depletions and Additions

Table 7-3 presents the calculated monthly differences between discharges of imported water (Table 7-2) and evaporative depletions of native tributary water (Table 7-1). On an annual basis, discharges of imported water (150 acre-feet per year) are currently about five times as great as evaporative depletions of natural tributary water (32 acre-feet per year). There is a net gain to the stream system.

7.1.6 Conclusions and Recommendations

Taking into account the anticipated hydrologic impacts under the interim operating period, it has been concluded that the stream regime downstream of Great Western Reservoir and Standley Lake will involve as much or more water than formerly seen as a result of the bypass of the two municipal storage reservoirs.

7.2 ECOLOGICAL ASSESSMENT OF THE SELECTED ALTERNATIVE

Implementation activities proposed by this document are subject to numerous federal and state environmental statutes which specifically address ecological issues. Of primary importance to this document are the Fish and Wildlife Coordination Act and the Endangered Species Act, which are discussed in Appendix A. These statutes require assessments for proposed activities that may impact terrestrial and aquatic habitats and their respective plant and animal populations.

Ecological assessment of the selected alternative will occur through the preparation and submittal of a formal Biological Assessment to the FWS for their review, and subsequent issuance of a Biological Opinion. Additional mitigation measures, or changes to the activities proposed in this document, may result from this Biological Opinion by the FWS. These changes, if any, cannot be predicted at this time. The proposed schedule for submittal of the Biological Assessment to FWS is 9 months after approval of this document.

7.3 PROPOSED MONITORING PROGRAM

Water quality and other monitoring programs implemented under the auspices of this document will build upon existing programs such that the overall coverage provided by sitewide monitoring programs is adequate to comply with regulatory requirements and to characterize flows, volumes, and water quality as water moves through the pond system. This IM/IRA document assumes that monitoring required under other regulatory mechanisms, or conducted by other programs, will continue; therefore, this section will not duplicate those requirements. In particular, biological/ecological monitoring and characterization efforts associated with the ponds and streams being addressed in this IM/IRA are not included in the proposed monitoring plan that follows. These efforts, although important, do not control day to day management activities. Summaries of current water quality monitoring programs and corresponding regulatory requirements are provided in Tables 3-4 through 3-10. Biological/ecological monitoring and characterization is more fully detailed in Appendix A.

The proposed monitoring program for this document includes the following components:

1. Data collection, trending, and other statistical evaluations of water quality monitoring conducted by other programs on upstream water sources including OUs, footing drains, incidental waters, WWTP effluent, seeps, and stormwater.

2. Quarterly sampling and analysis of ambient pond water quality. This monitoring will supplement rather than duplicate monitoring conducted under the NPDES permit program and the Watershed Management Plan.

3. Routine field monitoring of flows, pond levels, and piezometers and inclinometers within the reservoir embankments.

4. Continued monitoring of existing real-time flow, level, and water quality stations, and implementation of additional real-time monitoring capabilities. Proposed upgrades to this system include additional stations, equipment upgrades, and new technologies for monitoring organics, metals, and alpha radioactivity on a continuous basis.

5. Field measurement of turbidity, pH, conductivity, and nitrate on water transfers from Ponds A-3 and B-5 to Pond A-4.

6. An interim pre-discharge monitoring plan for Ponds A-4 and C-2 which will be phased out as improvements to the real-time monitoring network are made.

7. A discharge water quality monitoring plan which will apply to all potential discharge points, including Ponds A-3, A-4, B-5, and C-2.

8. Non-routine (supplemental) water quality sampling and analysis of A-series (North Walnut Creek), B-series (South Walnut Creek), or South Interceptor Ditch (SID) flows, spill ponds, or stormwater ponds in response to spills or

abnormalities in routine real-time pond or discharge monitoring results, in order to investigate/determine the potential source of contaminants.

9. Non-routine monitoring of water quality in the Landfill Pond or Ponds A-1, B-1, A-2, or B-2 in response to operational needs.

10. Non-routine monitoring of discharge water quality under defined emergency conditions, as specified in current or future emergency procedures for the dams.

Each of these monitoring plans is discussed in greater detail below. Summary information on all monitoring efforts will be reported to the agencies on a quarterly basis.

7.3.1 Upstream Data Collection and Evaluation

Information collection for the monitoring programs conducted at upstream locations is a matter of information transfer and coordination/evaluation of data. A majority of this sitewide water quality and flow information pertinent to pond water management is currently submitted to the agencies. Procedures will be implemented to add Surface Water personnel responsible for pond water management to the distribution list for this information. Other information specific to locations or parameters of interest will be retrieved from the Rocky Flats Environmental Database System (RFEDS). These data will be used to characterize the various sources of potential contaminants and evaluate trends in influent water quality.

7.3.2 Quarterly Pond Water Quality Monitoring

All ponds which receive water during a calendar quarter will have a quarterly sample taken for a representative list of parameters. The proposed list of analytes for quarterly sampling is given in Table 7-1 and is identical to the general characterization analyte list for Ponds A-4, B-5, and C-2 currently used with the exception of an additional whole effluent toxicity (WET) test requirement. Samples will not be taken until a minimum of 48 hours after the end of a precipitation event, in order to allow sediments transported in stormwater to settle out of the water column. The ponds which are maintained for spill control and receive no water other than minor localized runoff (e.g., Ponds A-1, A-2, B-1, and B-2) will not be sampled unless diversions into the pond occur within the quarter, water from a previous diversion is still held in the pond, or an action to do something with the water is contemplated.

Given the variability of weather conditions at the Site, the first quarter sample may be skipped if ponds remain frozen, or if high spring runoff conditions or muddy conditions make it difficult or unsafe to collect representative samples at a particular pond. Quarterly samples will be scheduled such that a minimum of 45 days elapses between successive samples. Quarterly pond sampling may be supplemented with an annual sampling for an expanded list of parameters. Annual sampling will depend on annual reporting requirements negotiated with regulatory agencies, or based on specific activities such as decontamination and decommissioning (D&D) activities. Quarterly and annual sampling will be used for reporting purposes, to check for contaminants missed by other programs, and to support trending analyses.

7.3.3 Field Monitoring

Routine field measurements of physical conditions will continue to be conducted according to existing protocols. Field activities will occur a minimum of once per week and will include the following tasks:

- Measurement of pond levels at Ponds A-3, A-4, B-5, and C-2.

- Measurement of flow at the A-1 and B-1 Bypass pipes.

- Measurement of piezometric levels and recording of inclinometer readings at Ponds A-4, B-5, and C-2.

- Visual inspection of dam conditions and side slopes at Ponds A-3, A-4, B-5, and C-2.

- Visual inspection of flumes, weirs, diversion gates and structures, outlet valves and structures, and automated monitoring/sampling equipment for signs of debris plugging or damage.

As described in existing emergency procedures, the frequency of field monitoring will increase as pond levels or flows increase. Field measurements will be recorded on standardized field data sheets that will be maintained in a central file within the Surface Water group, and will be made available to interested parties as requested. Field measurements will be used to calibrate existing and new real-time monitoring equipment, provide baseline information for operational decision-making, and assist development of revised hydrologic models and dam safety protocols.

7.3.4 Real-Time Monitoring

To supplement and eventually replace routine water quality sampling and analysis, and to improve the accuracy of field measurements, the existing real-time monitoring system will be expanded. Real-time monitoring of water quality is an emerging technology which holds the potential for early identification of water quality problems, leading to quick capture and control of contaminants and significant reductions in the cost of treatment, and sampling and analytical costs. Proposed locations were selected to match key influent water sources.

Specific analytes have not been determined, but are expected to be those parameters which can function as good indicators of overall water quality or those which are indicated by evaluation of event-related stormwater data or WWTP effluent data. Proposed additions are as follows:

1. At the A-1 and B-1 Bypasses, and on the discharge from the WWTP, a Hydrolab® will be installed to monitor representative water quality parameters (pH, conductivity, dissolved oxygen, etc.) influent to the ponds. In addition, real-time monitors to measure selected incoming inorganics such as cadmium, nitrate, and/or zinc, and a real-time alpha monitor, to measure incoming alpha radioactivity, are proposed.

2. On the discharge from the WWTP, real-time monitors will be installed to measure incoming concentrations of selected organic chemicals such as trichloroethylene (TCE) and chloroform.

3. On terminal pond discharges, real-time monitors for gross alpha and other specific analytes will be installed to measure outgoing concentrations of these parameters. (Note: A Hydrolab® currently exists at each of the terminal ponds.)

Selection, addition, or changes to analyte specific real time monitoring modules will be determined based on statistical analysis of analytical data generated by other monitoring programs, including quarterly, pre-discharge, discharge, and other upstream monitoring programs.

Although 13 locations are currently monitored for flow and other physical parameters in real-time, the need for expansion and upgrade of these capabilities is highlighted by the hydrologic evaluations performed in Chapter 6. The hydrologic mass balances that were analyzed as part of the alternative evaluation process clearly showed the weaknesses in the current monitoring system. The automated flow monitoring stations and automated pond level gages could not be used for mass balance calculations due to sporadic performance. A large percentage of the time the gages were not functioning due to ice or some other malfunction such as loss of power.

An improved program of monitoring is proposed. Although locations have not been selected, new gages that are well fortified to reduce the probability of damages due to external elements, and to reduce the probability of poor measurements due to ice build-up are proposed. More reliable electricity supplies will also be investigated. All automated gages will be backed-up by traditional observation gages in the event that the automated gage is not functioning. In addition to flow monitoring stations described above, existing piezometers and inclinometers not currently instrumented will be fitted with level sensors and transmitters, and new rain gages will be installed and instrumented for each drainage basin.

All new real-time monitors will be linked to the existing network of stormwater flow stations and automated samplers via radio telemetry. A routine calibration schedule will be established to ensure the reliability of real-time monitoring data.

7.3.5 Field Monitoring for Transfers

Under initial batch mode operations, water in Ponds A-3 and B-5 awaiting transfer to Pond A-4 will be field tested for turbidity, pH, conductivity, and field nitrate prior to transfer. As the controlled detention and discharge mode of operations is implemented, daily field tests for turbidity, pH, conductivity, and field nitrate will be conducted on water being transferred or discharged.

7.3.6 Interim Pre-Discharge Monitoring

A revised, transitional pre-discharge monitoring plan is proposed for initial implementation, with elimination of routine pre-discharge sampling and analysis proposed as real-time techniques are implemented and proven. Proposed transitional pre-discharge monitoring Ponds A-4, B-5, and/or C-2 under initial batch mode operations and include a standard analyte suite consisting of the Contaminants of Concern (COCs) list from Table 4-23, supplemented by additional parameters on a case by case basis. COCs will be updated quarterly based on statistical evaluation of quarterly and pre-discharge analytical data. Proposed Practical Quantitation Levels (PQLs) for pre-discharge analytical testing are state defined PQLs for metal, organic, and inorganic parameters, (CDPHE 1993) and Atomic Energy Commission Derived Concentration Guides (DCGs) for radionuclides. The proposed analyte suite and PQLs were selected as protective, reasonable, and achievable, consistent with CERCLA guidance (EPA 1991) and state regulation (CDPHE 1993), and will shorten analytical turnaround time from the current 18 day average to approximately 10 days based on shorter analytical time necessary for alpha/beta versus specific radionuclides.

As real-time monitoring techniques are phased in and proven, pre-discharge sampling and analytical efforts will be correspondingly phased out. This will occur on a parameter specific or indicator specific basis such that important parameters remain continually covered by the monitoring program. For example, installation, calibration, and testing of proposed real-time monitoring modules will eventually result in deletion of specific analytes or groups of analytes from the pre-discharge sampling and analytical list. Similarly, development of correlations between conductivity, total suspended solids (TSS), total dissolved solids (TDS), or other indicators may allow deletion of specific metals, groups of metals, or certain radionuclide parameters from the pre-discharge analyte list.

7.3.7 Discharge Monitoring

The proposed discharge monitoring plan consists of a tiered approach where different parameters are monitored on different schedules, similar to typical NPDES discharge permits. Discharged waters will be sampled daily and composited weekly for specific radionuclides, weekly for non-volatile suspended solids, nitrate, and alpha and beta activity, once per month for COCs excluding radionuclides, and once per quarter for WET. Additional parameters or lists of parameters will be monitored quarterly according to the schedule given in Table 7-6 at times when a discharge sample is intended to replace a regularly scheduled quarterly in-pond sample. The proposed discharge monitoring plan will remain in effect regardless of the mode of operations until and unless changes are negotiated and approved by regulatory personnel.

Interpretation of analytical results will be consistent with the methodology by which individual standards were established. This approach is designed to approximate the way in which typical discharge permits are written, and incorporates averaging techniques used by regulatory personnel to establish specific effluent limitations. For example, metals standards established to protect aquatic life designations for the receiving stream (Segment 4) are based on acute and chronic exposure levels to fish and other aquatic species. Effluent limitations specify daily maximum concentrations (acute exposure) and monthly average concentrations (chronic exposure). Volatile organic compounds and radionuclides are evaluated in a similar manner with the exception that ingestion by humans is the important consideration. Organic chemical standards are based on EPA Gold Book fish and water ingestion criteria, and radionuclide DCGs are based on ingestion of 2 liters per day of water over a year's time (730 liters). Both represent chronic exposure conditions for which averaging methods are appropriate.

Of the 29 regulated pollutants for which site-specific effluent limitations are established in the Draft NPDES permit, 24 are based on Colorado water quality standards. Of these 24, 21 establish effluent limitations based on 30-day averages (DOE 1994a). Recognizing that discharges from the ponds are not continuous, a 90-day averaging method (i.e., the average of three monthly samples for COCs) will be used in evaluating chronic exposures. This is consistent with the approach used for discharge permits where a monthly average is made up of 4 weekly samples. Daily maximum values, or in this case "sample" maximum values, will also be evaluated against acute exposure standards.

Parameters, sample frequency, averaging method, and selected Applicable or Relevant and Appropriate Requirement (ARAR) for evaluating discharges to Segment 4 are shown in Table 7-6. Pre-discharge, real-time, and discharge monitoring results will be summarized in quarterly reports to regulatory agencies.

7.3.8 Non-Routine Event-Related Monitoring

Sampling and analytical efforts in response to spills or other abnormal events can not be definitively identified at this time, but will include locations and parameters specific to the event and will be conducted in accordance with the current procedure for *Contaminant of Spills within the Rocky Flats Drainages* (EG&G 1993a). (Note: This procedure is currently being revised.) For example, a suspected spill of nitric acid tributary to the A-series drainage (North Walnut Creek) would result in closure of the A-1 Bypass pipe and diversion of water into Pond A-1. Monitoring specific to nitric acid and nitric acid byproducts would be conducted in drainage ditches immediately downstream of the spill site, along affected portions of North Walnut Creek, and within Pond A-1 in order to confirm the spill and characterize water quality impacts. Additional monitoring at stormwater Pond A-3 may be conducted if it is suspected that a portion of the spill made it past the Bypass gate prior to being closed. Periodic monitoring will continue until concentration levels indicate the water quality within the stream reach will not impact the ability to meet Segment 4 standards, thus allowing the A-1 Bypass pipe to be reopened.

A similar monitoring effort will be conducted in response to abnormal water quality results from upstream monitoring programs such as the Industrial Area (IA) footing drain monitoring program. The first step is to divert suspect water, followed by sampling to confirm the presence, source, and concentration of the contaminant. Response actions will be initiated and conducted by other programs. Surface Water staff will provide water quality data and management recommendations to responsible organizations.

7.3.9 Operational Monitoring at Ponds A-1, A-2, B-1, B-2, and the Landfill Pond

Proposed monitoring associated with contemplated operations at Ponds A-1, A-2, B-1, B-2, and the Landfill Pond (e.g., spray evaporation or transfers) is limited to pre-operational sampling and analytical efforts necessary to characterize water quality. Unlike the stormwater ponds, these five ponds are subject to hazardous waste determination requirements under Resource Conservation Recovery Act (RCRA). Thus, the selected analyte list must be an appropriate representative subset of the complete EPA RCRA hazardous constituent (40 CFR 261 App. VIII) list to be used for characterization purposes.

The proposed analyte list for determining whether water in the above mentioned ponds contains a hazardous waste was selected based on operational history and the COCs defined in Chapter 4. This list includes Table 7-7. Although individual ponds have slightly different operational histories, the proposed list has been standardized to apply to all of the above five ponds, and includes all defined COCs for water as well as Toxicity Characteristic Leaching Procedure (TCLP) parameters (Table 1, 40 CFR 264.24). As a result, the list is considered conservative.

7.3.10 Emergency Monitoring

Monitoring proposed in response to emergency conditions at the dams is identical to requirements found in existing procedures. Emergency conditions at the dams are strictly volume related, and water will be released regardless of water quality in order to prevent catastrophic events such as dam failure, which have onerous downstream health and safety impacts. Prior to emergency release conditions where releases are controlled, and during uncontrolled release through the spillway, sampling will be conducted on water being discharged. Downstream soils will be sampled after the discharge to determine if contaminants escaped and whether remediation measures might be required in the future.

On-site monitoring programs proposed above in no way preclude EPA or CDPHE personnel from performing identical, additional or concurrent sampling at their discretion. However, the above monitoring programs are designed to be adequate for determining the quality of water discharged to segment 4, and will be performed irrespective of the timing or analyte lists chosen by the agencies for their purposes.

7.4 ADMINISTRATIVE PROTOCOLS AND PROPOSED DECISION CRITERIA

As this decision document is implemented, protocols and decision criteria for routine operations will change as initial batch discharge operations change to routine controlled detention and discharge. Conversely, operational protocols for non-routine and emergency operations will remain quite static. Proposed protocols for each category of operations are described below.

7.4.1 Routine Operations

Routine operations are defined as water management activities conducted in response to normal precipitation, flows, and volumes, and absent identified water quality or dam safety problems. Protocols for routine operations will be based on analysis of data and assumes water influent to the ponds is of similar quality to that historically collected by the ponds. Routine protocols and decision criteria apply only to Pond B-3, and to the stormwater control Ponds A-3, A-4, B-4, B-5, and C-2. Since it is a stated intent of this decision document to minimize inflows to and use of Ponds A-1, B-1, A-2 and B-2, water management activities at these ponds are considered non-routine. The following general protocols, practices, and decision criteria are proposed for routine water management operations:

1. Routine management of water in Pond B-3 will be identical to current practices until such time as new tankage for WWTP upsets identified by the IA IM/IRA is installed. To summarize, Pond B-3 will continue to receive daily discharges from the WWTP via the existing pipeline, and will discharge through a controlled outlet to Pond B-4 on a daily basis, during daylight hours only.

Flows from Pond B-3 will be regulated such that sufficient water is released on a daily basis to allow retention of effluents during evening hours and in order for a visual inspection to be conducted for oil sheens or other obvious upsets. Responsibility for operation of the outlet works at B-3 (opening in the morning and closing in the evening) will be conducted by Regulated Waste Operations personnel (i.e., WWTP operators).

Implementation of this IM/IRA document will not change normal routing of WWTP effluent conducted under the provisions of the new NPDES permit. Effluent will continue to flow to Pond B-3, with subsequent release to Pond B-4 and Pond B-5. However, once the new tankage, specified by the IA IM/IRA is in place, the order of usage under spill/upset conditions is expected to change as follows: tankage will be used as primary upset control unless tanks are already retaining water and awaiting disposition, Pond B-1 will be used for secondary control, and Pond B-2 will be used for tertiary control.

2. Pond B-4 will continue to be maintained at essentially 100 percent full and operate as a flow-through pond. Maintenance of the spillway structure and cleaning of the outlet grate at Pond B-4 will be specified by Surface Water field personnel as needed, and performed by Site labor crews.

3. Transfer operations at Pond B-5 will transition over time from batch mode operations to controlled detention and discharge operations. During initial implementation of this IM/IRA, Pond B-5 will be operated in batch mode. Transfers to Pond A-4 will be initiated at the discretion of Surface Water operations personnel any time Pond B-5 volume exceeds 25 percent, subject to the transfer monitoring requirements previously proposed. Batch transfers will be conducted using existing pumps and piping to Pond A-4. Batch transfer decision criteria were selected to reflect typical indicator parameters and concentration levels indicative of normal stormwater quality. Decision criteria are proposed as follows:

- Turbidity - less than 50 NTU.
- Conductivity, pH, and field nitrate within normal ranges. (Conductivity below 1,000 mmhos/cm^2, pH range 6.0 to 9.0, nitrate less than 10 mg/L.)

Normal maximum volume for Pond B-5 is specified as 50 percent of spillway elevation. To avoid emergency conditions, transfers of water from Pond B-5 to Pond A-4 will be initiated as soon as possible after Pond B-5 volume reaches or exceeds 50 percent, regardless of whether Pond A-4 is in a discharge mode.

The second step in the transition from batch mode to controlled detention and discharge operations proposes batch mode operations during normal flows with immediate transfer to Pond A-4 during high flow regimes. This mode of operations will relieve dam stresses caused by high inflows and will be implemented as soon as feasible. This mode of operations assumes batching of waters in Pond A-4 is continuing.

The third step in the transition process is to perform routine concurrent transfers of Pond B-5 to Pond A-4 while Pond A-4 is discharging. During this phase, concurrent transfers will be subject to 48-hour settling times for storm events and field monitoring requirements, but will occur at volumes below 50 percent at the discretion of operations personnel. This operational mode will be implemented after an intermediate step of analyzing/correlating real-time water quality data against quarterly in pond analytical results has been performed for a minimum of two quarters. This transitional operations mode for Pond B-5 also assumes that initial batching and pre-discharge analytical effort at Pond A-4 will continue to be performed prior to the initial discharge from Pond A-4.

Final achievement of full-time routine controlled detention and discharge operations at Pond B-5 will correspond to full-time routine controlled detention and discharge operations at Pond A-4. Alternatively, Pond B-5 will begin discharging directly to South Walnut Creek through its outlets works rather than transferring to Pond A-4. This mode of operations will be implemented after the real-time monitoring network is fully installed and functional, and an adequate data record has been accumulated and evaluated. During this mode of operations, the previously discussed field monitoring provisions for turbidity and other field parameters will be conducted daily on discharges from any of the terminal ponds. Required discharge sampling efforts will also continue. In addition, discharges will be discontinued for 48 hours after storm events of greater than ½ inch to allow settling of suspended matter in the stormwater flows.

4. Proposed routine operations at Pond A-3 are very similar to those described for Pond B-5 above. During initial implementation of this IM/IRA, Pond A-3 will be operated in batch mode with the exception that transfers to Pond A-4 will occur through the outlet works of Pond A-3. Transfers to Pond A-4 will be initiated at the discretion of Surface Water personnel any time Pond A-3 volume exceeds 25 percent. Initial transfer decision criteria for Pond A-3 are identical to proposed transfer criteria for Pond B-5:

- Turbidity - less than 50 NTU.

- Conductivity, pH, and field nitrate within normal ranges. (Conductivity below 1,000 mmhos/cm^2, pH range 6.0 to 9.0, nitrate less than 10 mg/L.)

Normal maximum volume for Pond A-3 is specified as 90 percent of spillway elevation. To avoid spillway discharge, transfers of water from Pond A-3 to Pond A-4 will be automatically initiated if spillway overflow is imminent, regardless of whether Pond A-4 is in discharge mode.

As the transition to controlled detention and discharge operations occurs and real-time monitoring is implemented, A-series baseflows will be transferred to Pond A-4 on a daily basis, subject to daily field monitoring.

5. During initial implementation of this IM/IRA, Pond A-4 will continue to be operated in batch mode, receiving water from Ponds A-3 and B-5 as discrete transfers, holding this water pending receipt of pre-discharge analytical results, and discharging this water as a discrete volume prior to receiving additional transfers. The maximum volume for Pond A-4 is specified as 65 percent and will not be exceeded under routine operational protocols due to the extended hold times required to obtain pre-discharge analytical results. Concurrent transfers to Pond A-4 will be conducted at the discretion of Surface Water personnel, according to the decision criteria for Ponds B-5 and A-3. Decision criteria for beginning Pond A-4 discharges are proposed as follows:

- Receipt of pre-discharge analytical results showing no exceedances of ARARs, or

- Measured parameters, except for isotope-specific radionuclides, do not exceed ARARs by greater than one order of magnitude, and agency (EPA and/or CDPHE) personnel are consulted prior to beginning discharge.

All discharges from Pond A-4 will be conducted using existing outlet works. Routine pumped discharge from Pond A-4 will be discontinued but will remain available if needed.

During the transition from batch mode operations to controlled detention and discharge operations at other ponds, the key aspect of batch mode operations, i.e., pre-discharge analytical efforts, will continue at Pond A-4. As the real-time monitoring network is fully implemented and evaluated, controlled discharges from Pond A-4 will occur on a daily basis, at flow rates corresponding to influent baseflow rates from Ponds B-5 and A-3. A minimum pool level of 10 percent will be maintained, and discharges will be temporarily suspended until sufficient volume is available (approximately 15 percent) to conduct daily discharges.

6. During initial implementation of this IM/IRA, Pond C-2 will continue to be operated in batch mode, receiving stormwater runoff through the SID, and discharging this water via existing pipeline to the Broomfield Diversion Ditch or, if needed, to Pond B-5 and/or Pond A-4. Discharges will be conducted as a discrete batch to the extent possible. After completion of the Standley Lake Protection Project (SLPP) portion of Option B, discharges will be routed to Woman Creek. Discharges will be timed for typically dry periods (February, September/October) to the extent possible to minimize predicted stormwater inflows during a discharge. Normal maximum volume for Pond C-2 is specified as 65 percent. The timing and pond level at which pre-discharge sampling will be conducted will be at the discretion of Surface Water personnel, but will automatically occur when Pond C-2 volume reaches 60 percent.

   Decision criteria for Pond C-2 discharges are proposed as follows:

   - Receipt of pre-discharge analytical results showing no exceedances of ARARs, or

   - Measured parameters, except for isotope-specific radionuclides, do not exceed ARARs by greater than one order of magnitude, and agency (EPA and/or CDPHE) personnel are consulted prior to beginning discharge.

   After completion of the SLPP, all discharges of water from Pond C-2 meeting Segment 4 standards will be conducted using existing outlet works which discharge to Woman Creek. Water exhibiting minor exceedances may be pump discharged from Pond C-2 to the Broomfield Diversion Ditch subject to consultation with the agencies. Transfer piping and pumps for transfers to Ponds B-5 and/or A-4 will remain in place for standby or emergency use.

   Due to the intermittent nature of inflows to Pond C-2, routine daily discharges from Pond C-2 are not proposed. Discharges will, however, be conducted over short time periods more or less routinely following storm events and settling. Proposed operational protocols for discharges from Pond C-2 include a required 48-hour settling time for inflows, and the field parameter monitoring and discharge sampling previously discussed for Pond A-4. A minimum pool level of 15 percent will be specified after discharges to allow for normal evaporation down to a minimum pool level of 10 percent.

7. Irrespective of the mode of operations or the status of Option B projects, the following routine operations will be performed as preventive maintenance tasks to ensure the reliability of water transfer and discharge facilities:

   - Consistent with USACE recommendations, outlet valves for Ponds A-3, A-4, B-5, and C-2 will be operated a minimum of once every six months, for a minimum of 30 minutes, to ensure their reliability, unless these outlet works have been used during the preceding six months for routine discharge operations.

   - Transfer piping from Pond C-2 to the Broomfield Diversion Ditch, and to Ponds B-5 and A-4 will be operated once per year in the spring, for a minimum of 2 hours, to check for leaks and ensure the reliability of diversion valves.

   - The existing treatment systems at Ponds C-2 and A-4 will be operated a minimum of once per quarter, for a minimum of 2 hours, to ensure these systems are in proper working order.

   - Flumes, weirs, diversion gates, outlet structures, and other water control and measurement devices will be cleaned of debris on a routine basis.

   - Necessary repairs identified during maintenance checks on the above facilities will be conducted.

   - As real-time monitoring equipment is installed, a routine calibration and servicing schedule will be established to ensure that each piece of equipment is serviced and recalibrated every 6 months. Spare units will be obtained so that units removed for servicing and calibration are immediately replaced, allowing all monitoring locations to remain on line to the greatest extent possible.

7.4.2 Non-Routine Operations

Non-routine operations are defined as activities that occur, on average, less than once per year, or in response to non-routine events. All treatment operations, if needed, all operations at the upper (i.e., A-1, A-2, B-1, and B-2) ponds, and all activities undertaken in response to spills or major storm events are considered non-routine operations. Proposed non-routine protocols and decision criteria for these operations are described in the following sections.

7.4.2.1 Stormwater Treatment Operations

Treatment operations for stormwater, potentially conducted at Ponds A-4 or C-2 during initial implementation of this IM/IRA, and at any terminal pond during future implementation, will be initiated after consultation with regulatory agencies, in response to gross exceedances identified by pre-discharge analytical efforts. Gross exceedances are defined as a greater than one order of magnitude exceedance of an applicable stream standard. As a first step in determining whether treatment is needed, the pond will be resampled for the specific analytes initially detected to confirm concentration levels.

A stormwater pond requiring treatment will be isolated to the extent possible from the rest of the system. As discussed earlier, contaminated stormwater is, by definition, not a hazardous waste, and RCRA containment requirements will not apply to stormwater ponds. The logistics of isolating particular stormwater ponds is discussed below. Treated water will be recycled to the pond from which it originated until additional analytical results indicate the contaminant(s) are successfully treated, at which time treated water will be discharged. Treatment operations will continue until the affected water volume has been treated and discharged.

Concurrent with treatment operations at Pond A-4, additional sampling and analysis will be conducted at Pond B-5, Pond A-3, and upstream locations to determine the source of the contaminant. The drainage contributing the contaminant will be allowed to transfer to Pond A-4, as needed, for collection of water for treatment. The unaffected drainage will continue to be managed under routine protocols and, if needed, based on retained volumes, will be discharged directly to lower Walnut Creek bypassing Pond A-4. For example, if the contaminant source is in stormwater in the B-series drainage, pipelines may be installed from Pond A-3 to below Pond A-4 to allow direct discharge of Pond A-3, and a pipeline from Pond B-3 to below Pond B-5 will be installed to allow direct discharge of WWTP effluent. If the contaminant source is in the A-series drainage, Pond B-5 will be allowed to discharge directly to lower Walnut Creek through its outlet works.

For treatment operations at Pond C-2 prior to implementation of an upgraded treatment system at Pond A-4, a similar approach will be used, with the exception that all treated water will be pumped to the Broomfield Diversion Ditch (prior to full completion of Option B) rather than discharged to Woman Creek. Since influent waters to Pond C-2 can not be redirected or isolated, treatment operations at Pond C-2 will continue until the source of contamination is found and remediated, or until influent water quality monitoring indicates the contaminant is no longer present. After the upgraded treatment system is installed at Pond A-4, water in Pond C-2 may be transferred to Pond A-4 for treatment if existing treatment capabilities at Pond C-2 are inadequate to address the identified contaminant.

7.4.2.2 Operations at Ponds A-1, A-2, B-1, and B-2

As previously discussed, operations at these ponds are subject to hazardous waste determination requirements under RCRA and CHWA. Assuming a defined hazardous constituent is detected, the first step is to resample to confirm the presence and concentration level of the contaminant(s). Assuming the presence of a constituent is confirmed, RCRA and CHWA assume that the water is a "water containing a hazardous waste" until proven otherwise, and disallows certain operations. These hazardous waste concerns are assumed to apply at any time during implementation of this IM/IRA, unless regulatorily changed as part of formal rulemaking processes.

To assist the Site in determining operational protocols and decision criteria for these waters, CDPHE has provided the following guidance (Baughman 1993):

> Once analytical and/or historical information is available, the following criteria can be applied to the water:
>
> a) analysis reveals no detections for organic compounds except those that are naturally-occurring using standard analytical methods and
> b) analytes reveal as detections less than or equal to background levels plus two standard deviations for inorganic and naturally-occurring organic compounds using standard analytical methods and
> c) water does not exhibit any characteristic of a hazardous waste, or exceed any of the TCLP limits, as defined in CHWR Section 261, Subpart C and
> d) water does not contain any listed hazardous wastes, as defined in CHWR Section 261, Subpart D.
>
> If the water fails any of these items, further consideration is needed. However, if no hazardous wastes are present (items [c] and [d]) and no hazardous constituents are present above the limits presented in [a] and [b], then the water can be transferred or spray evaporated with no prior treatment.
>
> Any environmental media contaminated by hazardous waste, regardless of concentration levels, requires management as a hazardous waste until the media no longer contains the waste. Additionally, any environmental media containing hazardous constituents, regardless of concentration, should be managed as a hazardous waste. To determine when, or at what levels, contaminated environmental media no longer "contain" the hazardous waste or constituents, the Colorado Department of Public Health and Environment (CDPHE) has employed both a risk assessment approach and use of existing promulgated standards. The risk assessment approach involves quantitatively determining that the levels of contaminants in the media:

1) present a risk to human health less than or equal to 1×10^{-6}, using a risk analysis procedure approved by the Director, for carcinogenic compounds and
2) present a Hazard Quotient (HQ) less than 10 for non-carcinogenic compounds.

Materials that have been determined to contain amounts of listed hazardous waste and/or hazardous constituents that exceed a 1×10^{-6} carcinogenic risk or an Rfd HQ of 1.0 present an unacceptable risk to human health and must be managed as a hazardous waste or remedied appropriately. Therefore, appropriate treatment would be necessary before transfer or spray evaporation occurred.

This risk assessment can be a very time-consuming and costly undertaking further complicated by the fact that, if relevant toxicity information is not available for a constituent in question, a risk assessment cannot be completed and the contaminated material must continue to be managed.

Alternatively, therefore, for the media of groundwater and surface water, comparisons of the contaminant levels with available water quality standards is another option to determine if the media "contains" hazardous waste or constituents. For this comparison, CDPHE applies, for each chemical, the most stringent of the following:

a) applicable Colorado water quality standards
b) SDWA standards
c) CWA standards.

If the standards comparison approach is used, any surface water or groundwater whose contaminant levels exceeded the most stringent of the above standards must be managed as a hazardous waste or remediated (treated) appropriately. Therefore, appropriate treatment would be necessary before transfer or spray evaporation occurred.

If the contaminant levels are at or below the acceptable risk levels and/or the appropriate standards, the media is considered to no longer "contain" hazardous waste or constituents. Therefore, the water can be transferred or spray evaporated with no prior treatment.

Adopting the above interpretation as a decision criteria for operations at Ponds A-1, A-2, B-1, and B-2, it is proposed that water meeting Segment 5 standards will be transferred, spray evaporated, or otherwise managed at the discretion of operating personnel, with no additional actions required. Under the above assumption, existing operational protocols and decision criteria associated with physical limitations of these ponds will continue to govern movement of water at and between these ponds.

If water quality in the above ponds does not meet Segment 5 standards, risk assessment studies will be initiated. Alternatively, since formal risk assessment determinations can be a long and rigorous process, water not meeting Segment 5 standards will be sent to available on-site RCRA/CERCLA treatment facilities. By doing so, this document does not assume that water that exceeds Segment 5 standards is a hazardous waste, or contains a hazardous waste, but only proposes this action as a conservative response to an unknown situation.

Selection of an appropriate treatment facility will depend on the constituent(s) in question. Available facilities include the Operable Unit (OU) 1 and 2 facilities, which eventually discharge back to the pond system, OU 4 evaporators, Building 374 evaporators, or the WWTP, which is allowed to receive low levels of potentially hazardous constituents as defined by the NPDES permit. Treatment facilities at Pond A-4 will not be used to treat water from Ponds A-1, A-2, B-1, or B-2, regardless of concentration levels, in order to avoid commingling of waters having potentially different regulatory classifications.

7.4.2.3 Major Storm Events

Storm events on the order of the 6-hour, 25-year storm event (approximately 3 inches of precipitation) or greater have the potential to simultaneously inundate all ponds in the system, including the ponds maintained for spill control. Under these conditions, it is probable that pond levels will quickly rise above safe storage levels, triggering implementation of the *Water Detention Pond Dam Failure* procedure previously discussed in Chapter 3.

Aside from specific actions defined in the *Water Detention Pond Dam Failure* procedure, it is possible that during initial implementation activities and prior to full implementation of controlled detention and discharge operations, water transfers and discharges without pre-discharge monitoring will be desirable to maintain operational flexibility during or immediately after major storm events. It is proposed that agency concurrence will be solicited prior to initiating alternative water management practices (i.e., transfers or discharges) in response to weather-related events that do not represent defined emergency conditions. Monitoring in accordance with Section 7.3.10 will also be conducted.

7.4.3 Emergencies

Emergency actions in response to dam safety considerations are defined in the *Water Detention Pond Dam Failure* procedure. In general terms, actions to relieve stresses on the dams by discharging excess water will be conducted irrespective of water quality considerations. Prior notice to regulatory agencies and downstream communities will be provided per procedural and regulatory requirements and as described in the emergency procedure.

Emergency actions taken in response to catastrophic events such as fires, explosions, or tank ruptures require activation of the Site Emergency Operations Center (EOC), and notification of a wide variety of federal and state agencies. For these events, all water transfers, discharges, and other operations must cease until the situation can be properly evaluated. Subsequent actions are taken at the direction of senior EOC personnel. This mode of emergency operations will continue.

7.5 PROPOSED FACILITY UPGRADES

Upgrades to facilities include expansion of the real-time monitoring network, and improvements to water treatment capabilities. Implementation activities associated with these proposed components involves a variety of studies to define equipment capabilities, followed by purchase, installation, and testing of selected components. Tasks and activities pertinent to implementation of real-time monitoring are given in Section 7.5.1. Tasks and activities pertinent to improvements in water treatment capabilities are given in Section 7.5.2. A summary of all proposed tasks and activities is provided in Table 7-5.

7.5.1 Real-Time Monitoring

Proposed initial improvements to the real-time monitoring network, including components and locations, have been previously discussed. Identified components are commercially available; thus, initial implementation activities consist of procuring, installing, and calibrating the identified equipment. Upgrades to existing monitoring stations and installation of new stations will be prioritized based on location.

The goal of achieving future controlled detention and discharge operations is ultimately dependent on reliably demonstrating that the real-time monitoring network can consistently and accurately characterize water quality influent to the ponds. To support this goal, installation of real-time monitoring stations to assess influent water quality will receive highest priority. Priority locations are selected as the A-1 and B-1 Bypass locations. These locations are proposed to be installed and operational within 6 months of approval/acceptance of this document.

Second in priority are monitoring upgrades on WWTP effluent. These upgrades are proposed for implementation within 18 months of approval of this document, or as specified in the final NPDES permit, which in some respects duplicates proposed monitoring upgrades contained in this document.

Third in priority are monitoring upgrades and new capabilities for measuring physical/ hydrologic conditions throughout the systems. Within this priority, initial efforts will focus on fixing calibration and operational problems at the current monitoring locations. Although important to proactive operational decision-making, new components are less important in achieving the goal of controlled detention and discharge operations than other monitoring components which target influent water quality. Physical/hydrologic monitoring components, such as additional flow and pond level monitoring devices, rain gages, and additional instrumentation for piezometers and inclinometers will be installed as budgetary considerations allow, with complete implementation of these components within 2 years of approval of this document.

Last in priority for real-time monitoring upgrades are water quality monitors on downstream discharges. Since routine sampling and analytical efforts will continue to be conducted on all discharge water, supplementary real-time monitoring of discharges provides limited useful data in the short-term. Discharge monitors are proposed for implementation within 2 years of approval of this document, although early installation of monitors at Pond A-4 may occur as budgetary considerations allow.

Operations will transition from initial batch mode operations to controlled detention and discharge operations based on analysis and trending of real-time monitoring data against corresponding laboratory analytical results. Technical memoranda for real-time monitoring performance data are proposed at 6-month intervals for two years, and will incorporate and analyze analytical data from quarterly samples plus, within the 6-month period, any pre-discharge and discharge sampling that occurs. Technical memoranda will be forwarded to regulatory agencies for their review. Each successive memorandum will incorporate all previous information. The third and fourth memorandum will propose preliminary and final constituents and levels to be used by the real-time monitoring system during controlled detention and discharge operations as indicators of potential water quality problems. These indicators will be used to trigger discontinuation of transfers or discharges until formal sampling and analysis is conducted to prove or disprove potential exceedances. Final selection/approval of indicator parameter and levels, and implementation of routine controlled detention and discharge operations will occur within 6 months after issuance of the final technical memorandum, or earlier, with concurrence from the agencies.

An additional technical memorandum pertaining to physical/hydrologic aspects of the real-time monitoring network will also be prepared. The proposed schedule for preparation of this technical memorandum is two years after installation of monitoring components, or four years after approval of this document, whichever occurs first.

7.5.2 Treatment Upgrades

Existing treatment facilities at OUs and Building 374 have a wide range of capabilities but are limited to flow rates generally less than 50 gpm, and have limited excess capacity due to current usage. These facilities are therefore inappropriate for treating the large volumes and high flow rates that apply to stormwater discharges from Ponds A-4 and C-2. These existing facilities are, however, regulatorily approved to treat defined hazardous waste, and are capable of treating flows and volumes from Ponds A-1, A-2, B-1, and/or B-2 on a non-routine basis. It is proposed that existing facilities be used for treatment of A-1, A-2, B-1, and/or B-2 water, if needed. Proposed implementation activities for treatment of water in Ponds A-1, A-2, B-1, and B-2, if needed, include the following tasks:

1. Within 9 months after approval of this document, determine target analytes and available excess capacity of existing RCRA approved treatment facilities, and required components (e.g., pumps, pipeline lengths, power requirement, costs) to transfer water to each of the existing treatment facilities, and

2. Within 15 months after approval of this document, prepare and finalize a detailed implementation plan to expeditiously fund and construct necessary facilities, if needed. It is proposed that this plan define funding sources, assign project management responsibilities, and include properly approved construction drawings, specifications and other documents, but that physical construction of the facilities does not occur unless needed.

Each of the above tasks will be prepared as technical memorandum for this IM/IRA and forwarded to the agencies for their review.

Current treatment systems at Ponds A-4 and C-2 lack the capability to effectively remove dissolved metals and radionuclides to the levels required by stream standards. Although the combination of filtration and granular activated carbon is effective for suspended constituents and organic chemicals, new system components are needed to achieve a complete system capable of removing the full range of potential contaminants.

A phased-in approach for upgrades to the existing treatment systems at Ponds A-4 and C-2 is proposed. Although numerous technologies are commercially available to address existing treatment system deficiencies, the ability of these technologies to efficiently and economically achieve both low effluent concentrations and high flow rates have not been fully investigated. Research on existing and emerging technologies, including bench or pilot testing, particularly for radionuclides, is needed before selection and implementation of appropriate equipment can be accomplished.

Proposed implementation activities for treatment upgrades are as follows:

1. As an initial interim task, to be accomplished within 6 months of approval of this document, evaluate the availability and capabilities of emergency response contractors. Contractual arrangements will be made with one or more contractors to respond to water quality problems beyond the capabilities of the current treatment systems.

2. Within 9 months of approval of this document, a technical memorandum will be prepared (and forwarded to the agencies for their review) to investigate potentially applicable technologies for removal of low concentrations of dissolved metals and radionuclides from natural waters and to select specific technologies for pilot testing. The study basis will be removal of constituents below Segment 4 stream standards, and flow rates not less than 300 gpm, corresponding to minimum discharge flow rates at the terminal pond.

3. Within 15 months, a testing plan for pilot-scale investigation of selected technologies will be prepared. This plan will include provisions for "spiking" influent waters with low levels of metals and radionuclides, and a proposed schedule for conducting pilot tests. This plan will be forwarded to the agencies for review and approval since intentional contamination of a small volume of water is proposed as part of the treatment evaluation, foreseeably within isolated and contained batch tanks.

4. Within 24 months, selected new treatment system components will be procured, installed, and available for pilot testing and/or use.

5. Within 15 months after procurement and installation of the pilot facility, a report will be issued documenting the performance results of the pilot facility, including an analysis of seasonal variations, and will provide final recommendations for system improvements. Implementation of additional improvements will be identified and scheduled after consultation with agency personnel.

7.6 SCHEDULE AND IMPLEMENTATION

A complete summary of proposed implementation activities is provided in Table 7-5. Proposed schedules for individual activities were selected to achieve routine controlled detention and discharge operations approximately 2½ to 3 years after approval of this decision document. At that time, all major implementation activities will have been completed and it is anticipated that soon after, Option B will also be completed. The real-time monitoring network will be complete and have approximately 2 to 3 years of data with which to determine correlations of real-time data with hard analytical data. Upgraded treatment systems will be installed and operational. Procedures and operational protocols will be in place to handle unforeseen contingencies.

The schedule proposed in this section assumes that full funding of activities will be received at the times needed to achieve the specified schedule. If proposed implementation activities are only partially funded, the schedule for implementation of specific activities may change accordingly.

It cannot be predicted with any accuracy how long the interim measures proposed in this document will remain in effect. It is probable that active pond water management under the auspices of this document will continue for at least a decade. It is also reasonable to assume that the probability of significant contamination of surface water will decrease over time as cleanup activities progress and are completed. Reflecting these considerations, the proposed management plan and implementation schedule contained in this document are considered protective of human health and the environment and are consistent with the requirements and intent of interim measures. As conditions change, so will the strategy for pond water management. Future changes to pond water management will be determined in accordance with regulatory guidance.

901-004\45Acb\Chapters\Chap7

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U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Responses. 1991. *A Guide to Developing Superfund No Action, Interim Action, and Contingency Remedy RODs.* OSWER Directive 9355.3-02FS-3.

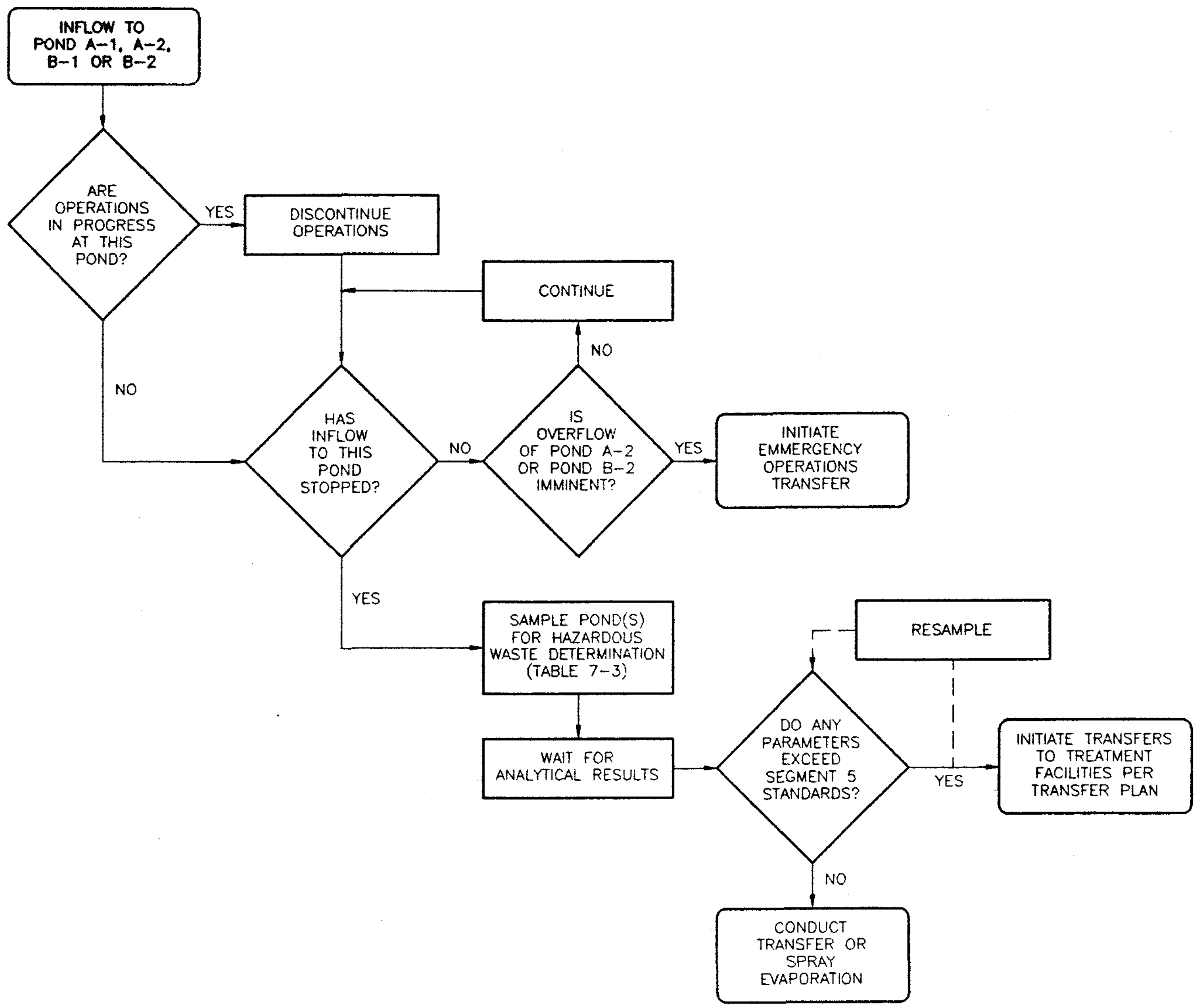


FIGURE 7-1
POND A-1/A-2 AND POND B-1/B-2 DECISION TREE

PREPARED FOR:

U.S. DEPARTMENT OF ENERGY

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

TITLE:

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

POND WATER MANAGEMENT IM/IRA DECISION DOCUMENT

PROJ. NO.	901-004.45A	DWG. NO.	–	SHEET
DESIGN BY	EWN	CHECKED	–	–
DRAWN BY	KAL	APPROVED	–	OF
DATE	SEPTEMBER 30, 1994	SCALE	–	–

INITIAL IMPLEMENTATION
(BATCH MODE OPERATIONS)

FINAL IMPLEMENTATION
(CONTROLLED DETENTION AND DISCHARGE)

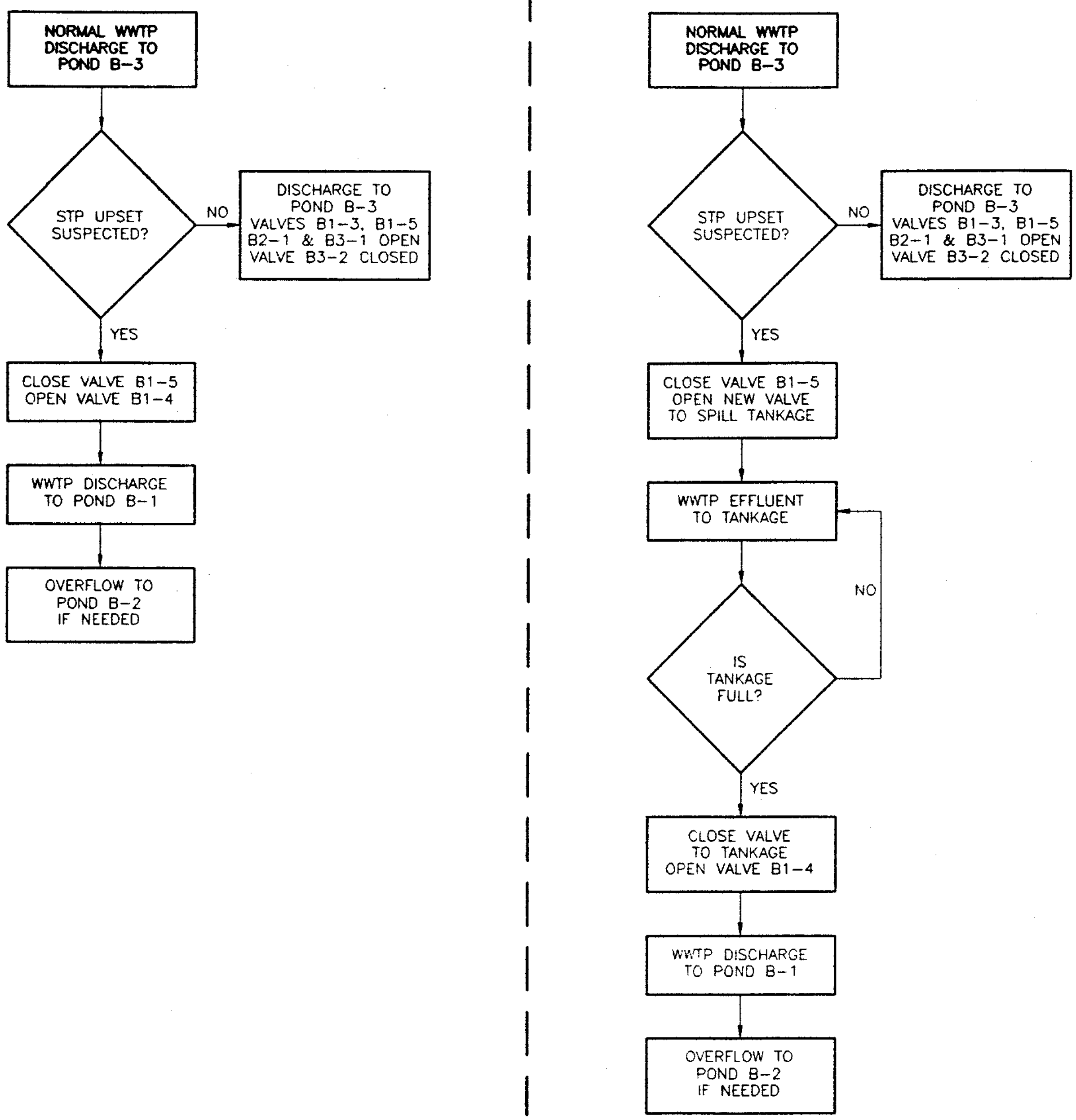


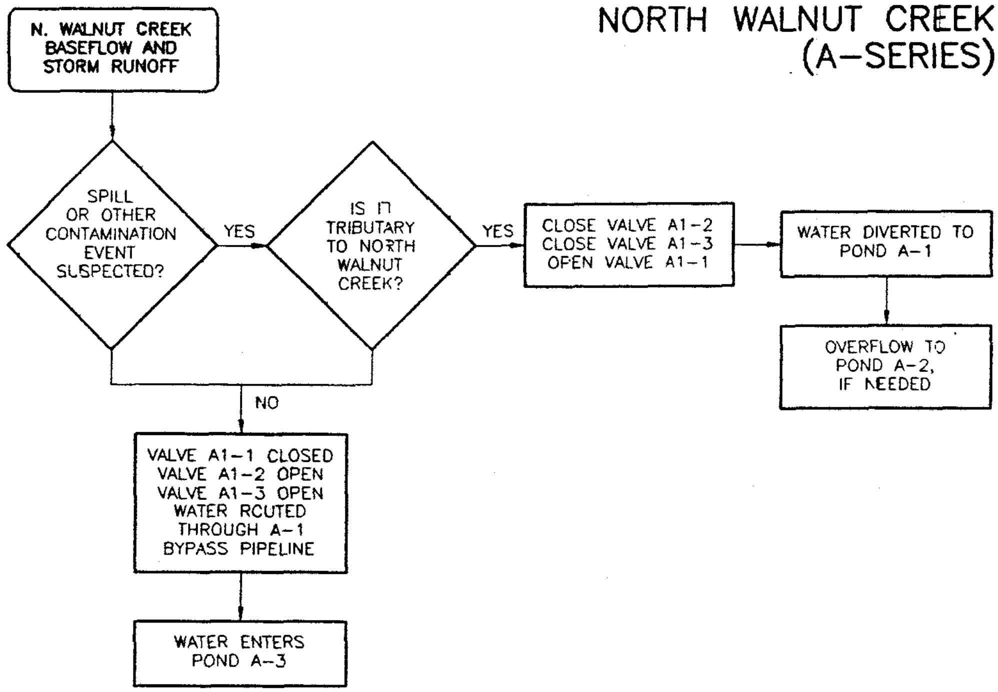
FIGURE 7-2
WWTP EFFLUENT DECISION TREE

PREPARED FOR:
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

TITLE:
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
POND WATER MANAGEMENT IM/IRA DECISION DOCUMENT

PROJ. NO.	901-004.45A	DWG. NO.	-	SHEET
DESIGN BY	EWN	CHECKED	-	-
DRAWN BY	KAL	APPROVED	-	OF
DATE	OCTOBER 14, 1994	SCALE	-	-

NORTH WALNUT CREEK (A-SERIES)



SOUTH WALNUT CREEK (B-SERIES)

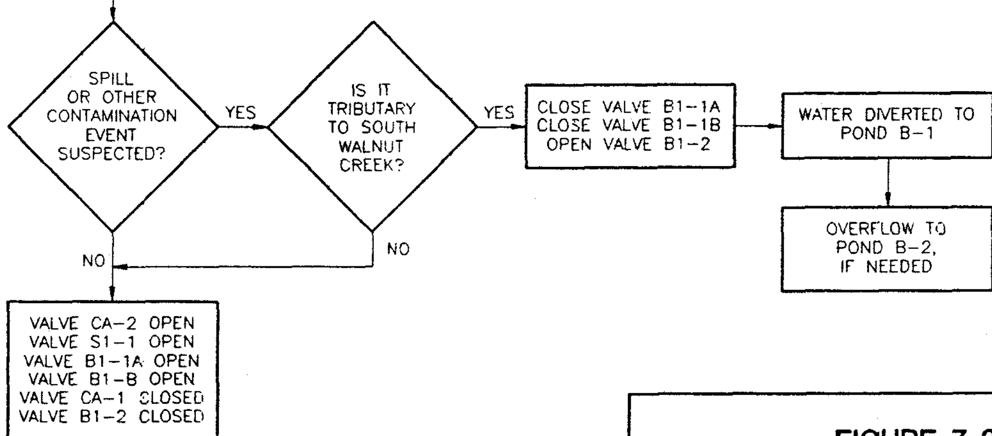


FIGURE 7-3
NORTH AND SOUTH WALNUT CREEK DECISION TREES

PREPARED FOR:
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ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

TITLE:
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
POND WATER MANAGEMENT IM/IRA DECISION DOCUMENT

PROJ. NO.	901-004.45A	DWG. NO.	–	SHEET
DESIGN BY	EWM	CHECKED	–	–
DRAWN BY	KAL	APPROVED	–	OF
DATE	SEPTEMBER 30, 1994	SCALE	–	–

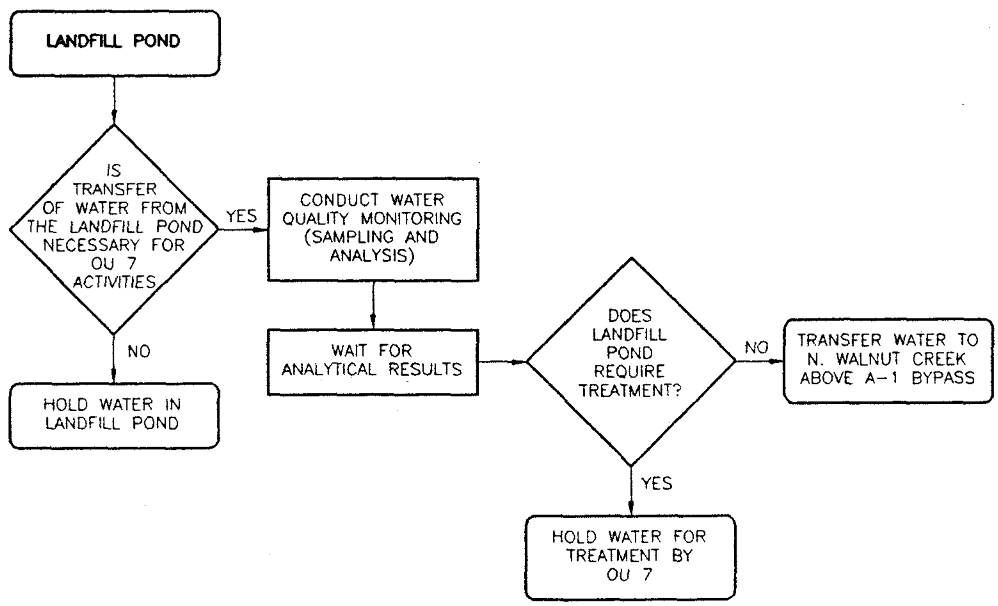

FIGURE 7-8
LANDFILL POND DECISION TREE

PREPARED FOR:
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

TITLE:
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
POND WATER MANAGEMENT IM/IRA DECISION DOCUMENT

PROJ. NO.	901-004.45A	DWG. NO.	–	SHEET
DESIGN BY	EWM	CHECKED	–	–
DRAWN BY	KAL	APPROVED	–	OF
DATE	SEPTEMBER 30, 1994	SCALE	–	–

TABLE 7-1
EVAPORATIVE DEPLETIONS OF NATIVE TRIBUTARY WATER AT THE SITE
(Acre-ft)

Month	1992	1993	1994
January	0.71	0.70	0.68
February	0.77	0.76	0.76
March	1.36	1.09	1.10
April	2.23	2.61	2.40
May	3.22	3.39	4.20
June	4.31	4.31	4.78
July	4.91	4.81	
August	4.86	4.56	
September	3.99	3.67	
October	2.88	2.76	
November	1.52	1.51	
December	0.83	0.81	
Annual Total:	**31.60**	**30.99**	

TABLE 7-2
NET DISCHARGE OF IMPORTED WATER AT THE SITE
(Acre-ft)

Month	1992	1993	1994
January	8.26	14.12	22.83
February	10.90	13.35	12.60
March	14.59	15.12	17.00
April	10.57	18.15	13.44
May	12.00	14.16	10.70
June	12.47	13.57	7.38
July	12.04	11.21	
August	13.31	10.93	
September	10.66	11.75	
October	11.76	10.72	
November	12.14	13.87	
December	15.20	13.65	
Annual Total:	**143.90**	**160.59**	

TABLE 7-3
NET ADDITIONS TO TRIBUTARY WATER AT THE SITE
(Acre-ft)

Month	1992	1993	1994
January	7.55	13.42	22.15
February	10.13	12.58	11.83
March	13.23	14.02	15.90
April	8.34	15.53	11.04
May	8.78	10.78	6.51
June	8.16	9.26	2.59
July	7.13	6.40	
August	8.45	6.37	
September	6.67	8.08	
October	8.88	7.96	
November	10.62	12.36	
December	14.37	12.84	
Annual Total:	**112.30**	**129.60**	

TABLE 7-4
WATER RIGHTS ON WALNUT, WOMAN, AND BIG DRY CREEKS

NAME	DECREED AMOUNT	ADJUDICATION DATE	APPROP. DATE	ADMIN. NUMBER	COMMENTS
WALNUT CREEK					
Great Western Reservoir	1595.74 AF	08/02/1918	04/21/1903	19468.00000	
Great Western Reservoir	1595.74 AF	08/02/1918	04/21/1903	19468.00000	
WOMAN CREEK					
Kinnear Ditch	40.47 cfs	08/02/1918	09/01/1869	15985.0718	Not to exceed 2720 AF annually
Standley Reservoir	940.36 AF	08/02/1918	09/01/1869	15985.0718	
Mower Ditch	6.6 cfs	12/31/1972	12/31/1872	44559.0840	Used to fill Mower Reservoir
Mower Reservoir	75.0 AF	12/31/1972	12/31/1872	44559.0840	Lies in District 6
BIG DRY CREEK					
Calkins Dry Creek Ditch	13.0 cfs	08/02/1918	09/15/1883	15895.1231	Limit 1480 AF annually
Whipple Ditch	5.0 cfs	08/02/1918	09/01/1884	15895.1266	Limit 300 AF annually
German Ditch	85.0 cfs	08/02/1918	11/25/1885	15895.131	Not to exceed needs of 1600 ACR
Big Dry Creek	36.66 cfs	08/02/1918	12/15/1889	15895.1459	Limit 1800 AF annually
Yoxall Ditch	16.8 cfs	08/02/1918	07/27/1896	17010.00000	Not to exceed needs of 320 ACR
German No. 2 Reservoir	92.5 AF	08/02/1918	09/12/1887	15895.1377	
German No. 3 Reservoir	19.51 AF	08/02/1918	09/12/1887	15895.1377	
German No. 4 Reservoir	36.14 AF	08/02/1918	09/01/1902	19236.00000	
German No. 5 Reservoir	23.31 AF	08/02/1918	09/01/1889	15895.1449	
German No. 6 Reservoir	22.95 AF	08/02/1918	03/17/1906	20529.00000	
German No. 7 Reservoir	6.88 AF	08/02/1918	09/01/1898	17776.00000	
German No. 8 Reservoir	54.41 AF	08/02/1918	09/01/1886	15895.1339	
German No. 9 Reservoir	18.36 AF	08/02/1918	03/17/1906	20529.00000	
German No. 11 Reservoir	9.18 AF	08/02/1918	09/01/1904	19967.00000	
German No. 12 Reservoir	91.82 AF	08/02/1918	09/01/1886	15895.1339	

NAME	DECREED AMOUNT	ADJUDICATION DATE	APPROP. DATE	ADMIN. NUMBER	COMMENTS
North Star Reservoir	128.97 AF	08/02/1918	04/04/1896	16896.00000	
Bull Canal Reservoir No. 6	5950.0 AF	12/31/1976	05/06/1976	46147.00000	Right to fill & refill
Harry Brown Ditch	3.3 cfs	12/31/1970	12/31/1985	43829.1680	
IDE Catch Basin #1	2.5 cfs	12/31/1986	5/22/1986	49815.00000	
IDE Lateral Ditch #1	56.2 cfs	12/31/1986	05/22/1986	49815.00000	
IDE Storage Pond #1	10.0 AF	12/31/1986	05/22/1986	49815.00000	
Jackson Gate Pipeline	0.067 cfs	12/31/1978	06/01/1978	46903.00000	
Jackson Gate Storage	0.25 AF	12/31/1978	06/01/1978	46903.00000	
Lower Church Lake	242.0 AF	12/13/1986	05/22/1986	49815.00000	AKA Mandalay Lake
Trostel Ditch	2.0 cfs	12/31/1980	10/29/1980	47784.00000	
Trostel Ditch	1.5 cfs	12/31/1980	10/29/1980	47784.00000	
Big Dry Creek	32.6	10/09/1895	12/15/1889	14594.00000	
S. Calkins Ditch	0.99 cfs	02/15/1888	12/31/1883	12418.00000	
S. Whipple Ditch	0.99 cfs	02/15/1888	12/31/1885	13149.00000	
S. German Ditch	0.99 cfs	02/15/1888	11/30/1885	13118.00000	Sufficient for 36 acres
S. Little Church Ditch	1.0 cfs	08/02/1918	07/01/1871	15895.0785	Transfer to Church Pond #4
Churches Lower Lake	135.96 AF	08/02/1918	07/01/1871	15895.0785	Also diverts from Draw
WATER RIGHTS DIVERTING FROM COAL CREEK INTO DISTRICT 2					
Church Ditch	18.11 cfs	06/02/1882	09/20/1870	7568.00000	
Kinnear Ditch No. 2	781.0 cfs	06/21/1926	03/04/1902	20890.19055	
Last Chance Ditch	1.3 cfs	06/02/1882	05/01/1862	4504.00000	From Eggleston Ditch No. 2
Last Chance Ditch	18.0 cfs	06/02/1882	06/01/1866	5996.00000	
Last Chance Ditch	10.78 cfs	06/02/1882	05/01/1870	7426.00000	
Standley Reservoir	940.0 AF	12/19/1900	09/01/1869	11841.07184	
Church Upper Lake	120.0 AF	12/19/1900	05/20/1870	11841.07445	

TABLE 7-4
(Page 3 of 3)

NAME	DECREED AMOUNT	ADJUDICATION DATE	APPROP. DATE	ADMIN. NUMBER	COMMENTS
Church Upper Lake 1st Enlargement	43.000 AF	12/19/1900	11/01/1891	15280.000	
Great Western Reservoir	296.0 AF	03/13/1907	04/21/1903	20188.19468	
Great Western Reservoir 1st Enlargment	1757.0 AF	02/09/1943	04/21/1903	27930.19468	
Kinnear Reservoir 1st Enlargement	49488.0 AF	06/21/1926	03/04/1902	20890.19055	AKA Standley
Last Chance Reservoir 1	45.5 AF	12/19/1900	04/01/1872	11841.08127	
Last Chance Reservoir 1 Enlargement	24.1 AF	12/19/1900	09/15/1885	13042.00000	
Last Chance Reservoir 2	68.2 AF	12/19/1900	04/01/1876	11841.09588	
Last Chance Reservoir 2 Enlargement	43.3 AF	12/19/1900	09/15/1884	12677.00000	
Smart Reservoir	236.6 AF	12/19/1900	09/01/1882	11932.00000	
Smart Reservoir 1st Enlargement	94.7 AF	12/19/1900	09/01/1882	15585.00000	
Smart Reservoir 2nd Enlargement	119.7 AF	06/21/1926	10/21/1909	21843.00000	
Smart Reservoir 3rd Enlargement	175.5 AF	07/17/1961	04/13/1956	38819.00000	Diligence
Smart Reservoir 3rd Enlargement	248.3 AF	07/17/1961	04/13/1956	38819.00000	Diligence
Smart Reservoir 3rd Enlargement	58.3 AF	07/17/1961	04/13/1956	38819.00000	Port of Condition Decree
Smart Reservoir Refill	743.8 AF	04/04/1964	06/15/1962	41073.00000	
Smart Reservoir Refill	131.1 AF	03/04/1964	04/15/1962	41073.00000	
Standley Ditch Reservoir	26.4 AF	06/02/1882	04/20/1872	8176.00000	

AF = acre-feet
cfs = cubic feet per second

TABLE 7-5
SUMMARY OF PROPOSED IMPLEMENTATION ACTIVITIES

Description of Activity	Proposed Deliverable/Milestone	Proposed Schedule[1]	Document Reference Section
Investigate legal and technical water rights issues.	To be determined	To be determined	7.1
Prepare Biological Assessment Report to U.S. Fish and Wildlife Service; requirements to document ecological impacts and mitigation measures	Biological Assessment delivered to U.S. Fish and Wildlife Service	9 months	7.2
Install real-time water quality monitoring devices at the A-1 and B-1 Bypass locations. Components to include Hydrolabs®, modules for selected inorganics, and a real-time monitor for alpha radioactivity.	Equipment installed and operational	6 months	7.5.1
Install real-time water quality monitoring devices at the outfall from the WWTP. Components to include modules for selected organic chemicals and a real-time monitor for alpha radioactivity.	Equipment installed and operational	18 months or as defined by new NPDES permit	7.5.1
Install real-time monitoring devices for physical/hydrologic parameters at selected locations within all drainages. Instruments will include flow gages, pond level monitors, rain gages, and instrumentation for piezometers and inclinometers.	Equipment installed and operational	2 years	7.5.1
Install real-time water quality monitoring devices on discharges from terminal ponds. Components will include real-time alpha monitors and other analyte-specific monitors at A-4, B-5, and C-2 discharge locations.	Equipment installed and operational	2 years	7.5.1
Evaluate performance data from real-time monitoring network against analytical results of quarterly pre-discharge and discharge sampling. Evaluate water quality trends. Develop indicator parameters.	Four Technical Memoranda at 6 month intervals	Memo 1 - 6 mths Memo 2 - 12 mths Memo 3 - 18 mths Memo 4 - 24 mths	7.5.1
Evaluate hydrologic aspects of ponds and drainages. Develop hydrologic model correlating precipitation to inflow, pond level, and required discharge rate. Calculate detention/settling times.	Technical Memorandum	2 years after equipment installation (approximately 4 years total)	7.5.1

[1] Proposed schedule is subject to document approvals and availability of funding.

TABLE 7-5
(Page 2 of 2)

Description of Activity	Proposed Deliverable/Milestone	Proposed Schedule[1]	Document Reference Section
Evaluate technical capabilities and availability (excess capacity) of existing treatment systems for treatment of water retained in Ponds A-1, A-2, B-1, or B-2.	Technical Memorandum	9 months	7.5.2
Prepare implementation plan for transfer of suspect water in Ponds A-1, A-2, B-1, or B-2 to selected treatment systems. Plan to include construction drawings and specifications and identify funding source.	Technical Memorandum	15 months	7.5.2
Investigate the capabilities and availability of emergency response contractors to treat suspect water. Make contractual arrangement with selected contractor.	Contract in place	6 months	7.5.2
Investigate technologies for removal of radionuclides and dissolved metals to Segment 4 standards for flow rates not less than 300 gpm. Select technologies for pilot testing.	Technical Memorandum	9 months	7.5.2
Prepare plan for pilot scale testing of selected technologies. Plan to include provisions/procedures for spiking influent waters with dissolved metals and radionuclides.	Technical Memorandum (Note: Spiking procedures will require approval of agencies)	15 months	7.5.2
Procure and install pilot scale treatment system components	Equipment installed and operational	24 months	7.5.2
Prepare report on performance results of pilot scale testing. Report to include evaluation of seasonal variations and make recommendations for improvements.	Technical Memorandum	15 months after installation of equipment	7.5.2
Implement recommendations of pilot scale test report	To be determined	To be determined	

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[1]Proposed schedule is subject to document approvals and availability of funding.

TABLE 7-6
PROPOSED DISCHARGE MONITORING

Analyte	Sample Frequency	Sample Type	ARAR
COCs (see Table 4-23)[1]	Weekly	Grab	See Table 5-2
Non-Volatile Suspended Solids	Weekly	Grab	see Table 5-2
Nitrate	Weekly	Grab	see Table 5-2
Plutonium-239/-240	Daily	Weekly composite	30 pCi/L
Americium-241	Daily	Weekly composite	30 pCi/L
Uranium-233/-234	Daily	Weekly composite	500 pCi/L
Uranium-235	Daily	Weekly composite	600 pCi/L
Uranium-238	Daily	Weekly composite	600 pCi/L
Tritium	Daily	Weekly composite	1,000 pCi/L
Semi-Volatile Organics Analytes (CLP)	Quarterly	Grab	See Table 5-2
Volatile Organic Analytes (Method 502.2)	Quarterly	Grab	See Table 5-2
Pesticides (Method 608)	Quarterly	Grab	See Table 5-2
Herbicides (Method 615)	Quarterly	Grab	See Table 5-2
Triazine Herbicides	Quarterly	Grab	See Table 5-2
Total and Dissolved Metals (TAL-CLP)	Quarterly	Grab	See Table 5-2
TSS, TDS, anions, nitrate, alkalinity	Quarterly	Grab	See Table 5-2
Whole Effluent Toxicity	Quarterly	Grab	

[1]COCs are pond dependent and will include gross alpha and gross beta as additional parameters. COC list will be evaluated quarterly and revised if needed.

Note: The list of analytes in the above table are somewhat duplicative; e.g., some COCs are also included in other lists of parameters. Only one sample of a particular analyte will be taken.

901-004\45Acb\Tab7-6

TABLE 7-7
PARAMETER LIST FOR HAZARDOUS WASTE DETERMINATIONS
AT PONDS A-1, A-2, B-1, B-2, AND THE LANDFILL POND

COCs (see Table 4-23)[1]

Arsenic[2]

Barium[2]
Benzene[2]

Cadmium[2]
Carbon tetrachloride[2]
Chlordane[2]
Chlorobenzene[2]
Chloroform[2]
Chromium III[2]
o-Cresol[2]
m-Cresol[2]
p-Cresol[2]
Cresol[2]

2,4-D[2]
1,4-Dichlorobenzene[2]
1,2-Dichloroethane[2]
1,1-Dichloroethylene[2]
2,4-Dinitrotoluene[2]

Endrin[2]

Heptachlor (and its epoxide)[2]
Hexachlorobenzene[2]
Hexachlorobutadiene[2]
Hexachloroethane[2]

Lead[2]
Lindane[2]

Mercury[2]
Methoxychlor[2]
Methyl ethyl ketone[2]

Nitrobenzene[2]

Pentrachlorophenol[2]
Pyridine[2]

Selenium[2]
Silver[2]

Tetrachlorethylene[2]
Toxaphene[2]
Trichloroethylene[2]
2,4,5-Trichlorophenol[2]
2,4,6-Trichlorophenol[2]
2,4,5-TP (Silvex)[2]

Vinylchloride[2]

Other[3]

[1]COC list for Ponds A-1, A-2, B-1, B-2, and the Landfill Pond include radionuclides (Pu, Am, U, H3). COC list will be evaluated quarterly and revised if needed.
[2]TCLP toxic contaminant from Table 1, 40 CFR 261.24.
[3]Spill specific contaminants as needed.

Note: The list of analytes in the above table are somewhat duplicative; e.g., some COCs are also TCLP toxic contaminants. Only one sample of a particular analyte will be taken.

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APPENDIX A
ECOSYSTEM ASSESSMENT

A.1 ECOLOGICAL REGULATORY DRIVERS

The considered alternatives must be responsive to a number of federal and state environmental statutes addressing specific ecological issues. These statutes constitute potential applicable or relevant and appropriate requirements (ARARs) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and must be factored into the Interim Measures/Interim Remedial Action (IM/IRA) process. Included are the Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), Eagle Protection Act, Fish and Wildlife Coordination Act (FWCA), and the Colorado Non-Game, Endangered and Threatened Species Conservation Act (CNETSCA). A brief description of each statute and its purpose follows.

A.1.1 Endangered Species Act

The purpose of the ESA is to provide federal protection for plants and animals listed as endangered or threatened and for the ecosystems that support and sustain them. Under Section 7 of this statute, federal agencies are required to consult with the U.S. Fish and Wildlife Service (FWS) to ascertain if their actions jeopardize the continued existence of listed species or otherwise may adversely affect those species and their critical habitats. As discussed in Chapter 5, the ESA is a potential ARAR.

A.1.2 Migratory Bird Treaty Act

The purpose of the MBTA is to provide federal protection for migratory birds, including their "take" of nests and eggs unless as permitted under regulations. While no consultation is required of federal agencies under the MBTA, strict liability, i.e. liability without a showing of negligence, applies. As discussed in Chapter 5, the MBTA is a potential ARAR.

A.1.3 Eagle Protection Act

The purpose of the Eagle Protection Act is to provide additional federal protection to bald and golden eagles beyond the MBTA. While no consultation provisions are required of federal agencies under this act, the concept of strict liability applies to civil violations. As discussed in Chapter 5, the Eagle Protection Act is a potential ARAR.

A.1.4 Fish and Wildlife Coordination Act

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration and is coordinated with other features of a project or activity. Federal agencies are mandated to consult with the FWS whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or otherwise controlled or modified for any purpose. The FWCA is an administrative requirement on federal agencies undertaking projects that are intrusive upon waters of the United States.

A.1.5 Colorado Non-Game, Endangered, and Threatened Species Conservation Act

The purpose of CNETSCA is to extend protection of State of Colorado species of plants and animals listed pursuant to the act. Protection afforded is primarily administrative in nature. Enforcement requirements are generally more strict under federal statute.

A.2 ECOLOGICAL INFORMATION AND DATA

The ecologies present within the Woman and Walnut Creek drainages have undoubtedly changed from their once pristine high plains intermittent stream-supported ecologies. Ecological structure is determined, in part, by species composition and abundance, temporal changes in communities, and relationships within communities. Ecological structure is also strongly influenced by physical structure. Current ecology in these drainages is, therefore, largely attributable to human-induced uses and modified circumstances resulting in largely undefined disturbances to pristine or natural community structure, guild and trophic level roles, and organizational and systems interactions. Consequently, for purposes of this IM/IRA document, discussion will focus on currently existing ecologies within the two drainages that have resulted from community adaptations to human interference and physical disruption.

The available hydrogeologic information was not collected specifically for the purpose of evaluating ecosystem function. However, the information collected to assess stormwater hydrology, baseflow conditions, and pond discharges does provide a general understanding of seasonal stream and pond conditions. This information is presented with the current delineation of riparian vegetation. Conclusions cannot be made concerning any connection between managed flow regimes in the streams and pond levels and existing terrestrial vegetation.

The currently available data on riparian ecology is primarily an inventory of existing species. The nature of this data does not allow conclusions about ecosystem requirements or function. Therefore, the information provided should only be considered as a baseline and not a determination on the way in which the Rocky Flats Environmental Technology Site (the Site) riparian ecosystems function.

A.2.1 Hydrogeological Information

Prior to 1989, discharges from the terminal ponds were conducted in a manner that detained stormwater for a short period of time to allow sediment settling and water quality analysis. The detention period was typically 48 hours after the end of the primary flow of stormwater. In 1989, a practice was implemented that detained water for longer periods until extensive water quality analysis could be completed (Chapter 3). This new procedure marked the beginning of "batch" discharges that currently drives the stream ecosystems and surrounding riparian ecology in Walnut and Woman Creek below the terminal ponds.

A.2.1.1 Walnut Creek

Flow records collected at Walnut Creek and Indiana Street (GS03), dating back to 1992 (Table A-1), show that higher flow conditions in Walnut Creek exist predominantly in the spring and may extend into the summer. Observations made throughout the year indicate that winter month flow conditions are the result of periodic snow melt conditions.

Flow in Walnut Creek is supported by groundwater exfiltration, discharges from the McKay Bypass, and shallow subsurface and surface runoff in the immediate catchment basin of the stream channel and stream bank storage associated with discharges. Baseflows are very small in comparison to discharges or storm flows. The seasonal nature of these baseflows indicates that local groundwater exfiltration on the scale of the watershed is primarily responsible. However, as discussed in Chapter 2, groundwater/surface water interactions are not well defined in the riparian corridors for Walnut Creek below Ponds A-4 and B-5 and currently cannot be quantified.

Table A-2 shows the extreme variations in pond water levels that have occurred since 1990 as well as normal operational fluctuations. The terminal Ponds A-4 and B-5 and Pond A-3 have the largest fluctuation due to the nature of batch discharges. The aquatic/terrestrial transition zone in these ponds is associated with the fluctuating shoreline and is in a state of constant flux. The interior Ponds A-1, A-2, B-1, and B-2 exhibit seasonal changes in pond levels that are only periodically altered by additions of water during dry periods. These interior ponds, with the exception of Pond A-2, have dried completely at least once during the last four years.

A.2.1.2 Woman Creek

The flow regime in Woman Creek is very different than that of Walnut Creek. Prior to 1990, Pond C-2 was discharged into Woman Creek just below the dam. In addition, Woman Creek was used as part of the Kinnear Ditch system that carried water to Standley Lake. Since 1990, discharges from Pond C-2 have been transferred to the Broomfield Diversion Ditch and Woman Creek has not been used as a water conveyance for Standley Lake. Smart Ditch 2 connects to the south tributary of Woman Creek and is used by land owners west of the Site for pasture flood irrigation. The return flows from this irrigation feed Woman Creek predominantly from May through July. At about the time that water management in Woman Creek was altered, downstream water users exercised their junior water rights to Woman Creek flows. The diversion structure to Mower Ditch (just east of Pond C-2) was modified so that all the flow in Woman Creek, less than approximately 1 foot in depth, is diverted to Mower Reservoir.

Lower Woman Creek is the area between the Mower Ditch Diversion Structure and Indiana Street. The effects from the last four years of managing water away from this stretch of the stream channel have not been evaluated. However, work performed on other stretches of Woman Creek and general field observations can be applied to Lower Woman Creek.

As part of the OU 5 Resource Conservation Recovery Act (RCRA) Facility Investigation/ Remedial Investigation (RFI/RI) piezometers were installed along Woman Creek upstream of Pond C-2. This study indicates that gaining and losing segments of Woman Creek are variable and associated with the local groundwater system. In Lower Woman Creek the same conclusions can be inferred. Tables A-3 and A-4 show flow rates in Woman Creek at Indiana Street (GS01) and Mower Ditch at Indiana Street (GS02), respectively. Since 1991, there has been flow in Woman Creek at Indiana predominantly during the spring months. High flows recorded in 1992 are the result of an uncontrolled bypass of Smart Ditch into Woman Creek. Since flows from the upper reaches of Woman Creek do not contribute to Lower Woman Creek, these spring flows must be due to the local groundwater system. The actual gaining sections of Lower Woman Creek that are responsible for these flows have not been identified. Since 1991 there has not been a significant enough precipitation event to produce storm water flows large enough to "top over" the Mower Ditch diversion structure. Review of the flow record in Mower Ditch shows that baseflow conditions typically begin earlier in the year and continue for a longer period of time. Isolation of Lower Woman Creek from the upper reaches has probably reduced the length and amount of baseflow.

The diversity associated with aquatic/terrestrial ecotones is partly due to the periodic disturbance of these systems. These disturbances include flooding and landslides along with more regional phenomena (Naiman 1990). In lower Woman Creek, characteristic spring flooding is the dominant disturbance. Current management of Lower Woman Creek precludes all but the most severe floods from affecting the riparian vegetation. Observations of the stream channel conditions just downstream of the Mower Ditch diversion structure confirm that xeric grasses such as western wheat *(Agropyron smithii)*, cheat grass *(Bromus tecteorum)*, and quack grass *(Agropyron repens)* are encroaching on the riparian corridor. Effects to the previously dominant species, coyote willow (*Salix exigua*), snowberry (*Symphoricarpos occidentalis*), plains cottonwood (*Populus deltoides*), and common cattails (*Typha lattifolia*) have not been measured.

Pond C-1, originally constructed for contaminant migration control, is operated as a flow-through system. Spring flows in Woman Creek slowly fill the pond to the level of its discharge structure. Continued flow in Woman Creek will then produce constant discharge at the rate of that flow. During drier periods the water levels in Pond C-1 will drop below the discharge point. Storm-related flows in Woman Creek are then attenuated only to the point that Pond C-1 is filled again. This attenuation varies based on the antecedent water level in the pond and the flow rate in Woman Creek. Beginning in 1990, when the use of Kinnear Ditch for water transfer through Woman Creek was stopped, the water levels in Pond C-1 showed a consistent recession during the summer months. In the summer of 1994, Pond C-1 dried completely.

Impacts to the ecology of Pond C-1 and the associated reaches of Woman Creek are a function of off-site water management practices. Pond management practices at the Site do not attempt to alter these off-site management practices. Therefore, pond management at C-1 is not considered in this document. However, since the movement of water in Woman Creek affects the riparian ecology, future assessment of the impacts of off-site water management on endangered species will be included in the Biological Assessment.

Pond C-2, like Ponds A-4 and B-5, has seen extreme fluctuations in water levels due to managed batch discharges. However, under normal operating conditions, releases from Pond C-2 are performed only seasonally. During dry periods when water levels are nearly constant, the lower drawdown zone of Pond C-2 revegetates with colonizer species that pioneer into temporarily bare soils.

Intense characterization of the physical and chemical conditions in Pond C-2 has shown that definitive layering of the pond, with regards to dissolved oxygen, occurs during the summer months. This layering is possibly a result of microbial activity in both the photic zone and near sediment zone. Table A-8 is a partial inventory of species collected from Pond C-2 during a period when layering was most pronounced.

A.2.2 Status and Qualification of Available Aquatic Data and Information

For purposes of this document, a characterization of the aquatic conditions arising in response to, and correlated with, past human-induced management actions is necessary before alternatives to pond management can be implemented. However, the physical and biological data collected to date is not correlated with past and current pond management activities to sufficiently provide this characterization. Aquatic data occurs in this conditional context because emphasis has been on water management/treatment demands with the sole objective of releasing water from the Site to meet National Pollutant Discharge Elimination System (NPDES) water quality discharge criteria and impoundment integrity criteria. Consequently, this section does not intend to derive any correlation between flow regulation and ecosystem function, nor does it imply predictive capacity between water management alternatives and possible ecological effects.

A.2.3 Vegetative Communities Supported and Sustained

Woman and Walnut Creeks support both permanent lentic and ephemeral lotic communities. The stream environments below the terminal ponds at the Site are generally known as riparian zones. This landscape pattern has been defined as "the interfaces between terrestrial and aquatic ecosystems. (They) are not easily delineated, but are composed of mosaics of landforms, communities, and environments within the larger landscape" (Gregory et al. 1991). In general terms, riparian communities are found wherever streams or rivers at least occasionally cause flooding beyond their channel confines or where new sites for vegetation establishment and growth are created by stream channel meandering.

In the past 50 years, these communities have been extensively modified by human activity in the western United States due to suburban development or agricultural impacts (grazing or water development). It has been estimated by the FWS that the Rocky Mountain region has lost 50 percent of riparian areas since 1940 (Abernethy and Turner 1987). Furthermore, the FWS has estimated that the Front Range of Colorado has lost 90 percent to 95 percent of these landscapes (FWS 1994). Through its exclusion of the general public on its property, however, the U.S. Department of Energy (DOE) has preserved some of these declining communities. The communities must be considered in any evaluation of water management alternatives.

The U.S. Army Corps of Engineers (USACE) has recently completed a wetlands delineation of the Site (USACE 1994). These wetlands range in size from 0.005 acres to complexes in excess of 10 acres, classified using the Cowardin system utilized in the FWS National Wetland Inventory. The stream wetland environments are mostly palustrine, defined as "nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens." Most are sub-classified as "Unconsolidated Bottom" or "Emergent" wetlands.

In Walnut Creek, below Ponds A-4 and B-5, for example, there are nearly three acres of palustrine wetlands in the stream channel or adjacent groundwater exfiltration zone. Woman Creek below Pond C-2 supports nearly 5 palustrine acres, plus 1.5 acres associated with Mower Ditch. Vegetation mixes below the terminal ponds primarily include the following species: Nebraska sedge (*Carex nebraskensis*), coyote willow, baltic rush (*Juncus balticus*), and false indigo (*Amorpha fruiticosa*), as well as mesic graminoid species such as western wheatgrass, redtop (*Agrostis stolonifers*), and slender wheatgrass (*Agropyron caninum*).

When considering the ecology of Site streams, it is important to note, however, that riparian zones above Ponds C-1 and A-1 have different vegetative compositions than those below the terminal Ponds C-2 and A-4. There are fewer mesic grasses or sedges and more woody or shrubby species such as plains cottonwood, peach leaved willow (*Salix amygdeloides*), and snowberry above the ponds. Furthermore, the stands of coyote willow and common cattail (*Typha lattifolia*) are more vigorous above the ponds. There are also fewer occurrences of the noxious weed Canada thistle (*Cirsium arvense*) above the ponds. In general, the riparian areas are much more diverse and rich above the point where the hydrologic regime is regulated. It is presently unclear whether the ponds are enhancing the upstream hydric profile or limiting the downstream profile to create such different vegetative conditions, but this trend is consistent with ecological models concerning the effects of stream regulation on landscape ecology (Ward et al. 1987).

The vegetative communities associated directly with the ponds are generally terrestrial in nature and are similar to stream communities: common cattail and coyote willow predominate. Species diversity is generally lower than the stream channels associated with the drainage, however. The pond fluctuation rates are such that aquatic vegetation typically associated with pond ecosystems cannot establish itself. These species, such as water lilies (*Nymphaia* spp.), pond weeds (*Potamogeton* spp.), and baldderwort (*Utricularia* spp.), can only exist under a more moderate drawdown cycle. During drawdown, invasive species such as foxtail barley (*Hordeum jubatum*), cocklebur (*Zanthium strumarium*), rabbitfoot grass (*Polyogon monspeliensis*), and barnyard grass (*Echinochloa spp.*) colonize the exposed sediments. These opportunistic annuals generally cannot exist in saturated soils and are only found in riparian areas when these specific conditions arise.

A.2.4 Faunal Communities Supported and Sustained

The importance of vegetative communities to the local faunal populations is very high. This is attributable to the "edge effect" between aquatic and terrestrial communities, defined as the "tendency for increased variety and density at community junctions" (Odum 1972). Unless the transition between communities (an ecotone) is very narrow, some habitats and, therefore, some organisms are likely to be found in the region of the overlap which are not present in either community alone. Species diversity is especially significant in these ecotones in the semi-arid climate of Colorado's Front Range, where these ecotones have been so substantially modified.

The permanent stream pools (the ponds) support macroinvertebrates such as flies (*diptera*), mayflies (*ephemeroptera*), beetles (*coleoptera*), and caddisflies (*trichoptera*). Together, there were 131 taxa of benthic macroinvertebrates collected in Walnut Creek and 84 in Woman Creek.

Phytoplankton and zooplankton populations are significant, but their levels depend on the occurrence of higher trophic level organisms (i.e., macroinverebrates, minnows, or bass). Ephemeral pools will generally support some of the above species but in lesser numbers and diversity. Specific information on types and frequency of these populations is currently unavailable (EG&G 1992).

Prairie rattlesnakes (*Crotalus viridus*) and bull snakes (*Pituophis melanoleucus*) frequent both the stream and pond environments. Frogs are not common but boreal chorus frogs (*Pseudacris triseriatus*) and northern leopard frogs (*Rana pipiens*) do occur. Western painted turtles (*Chrysemys picta*) are pond residents but are also found in stream channels during wet periods. Tiger salamanders (*Ambystoma tigrinum*) have been collected in the ponds (EG&G 1994a).

The fish species most commonly found in the permanent ponds and ephemeral pools are fat head minnows (*Pimephales promelas*). Other cyprinids such as golden shiners and white suckers are also common. Largemouth bass (*Micropterus salmonoides*) have also been collected in Pond A-2.

The importance of riparian areas to avian species is widely recognized. Colorado Partners in Flight (1994) estimates that these areas are used by more than 80 percent of Colorado's birds but these habitats make up less than 2 percent of the state's total land area. Great horned owls, marsh hawks, red tailed hawks, and numerous migratory songbirds seasonally reside in the stream areas. Game species such as wild turkey are occasional visitors. Occasional avian sightings in Woman and Walnut Creek riparian zones during migration include Cooper's hawks and various flycatchers. Peregrine falcons have been observed hunting in the stream community of Woman Creek.

Waterfowl are abundant in every drainage on Rocky Flats. The ponds support a breeding population of mallards and Canada geese. Great blue herons, black-crowned night herons, double crested cormorants, and pied billed grebes use the ponds from spring to fall. Also, the ponds are heavily utilized by waterfowl during spring migration. Teal, mergansers, shovelers, and pelicans are not uncommon in the spring. The ponds are also favored by killdeer, common yellowthroats, and red-winged blackbirds (EG&G 1994b).

Mule deer (*Odocoilus hemionus*) and coyote (*Canis latrans*) are highly abundant in riparian areas, as are raccoons (*Procyon lotor*), muskrats (*Ondatra zibethicus*), beavers (*Castor canadensis*), skunks (*Taxidea taxus*), meadow voles (*Microtus pennsylvaticus*), and field mice (*Peremyscus maniculatus*). These areas also contain important habitat for Preble's Meadow Jumping Mice, a candidate for the endangered species list.

A.2.4.1 Preble's Meadow Jumping Mouse

On August 19, 1994, the FWS received a Petition to List the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*), a Category C-2 candidate species, pursuant to the ESA. It is within the spirit of the ESA that federal agencies consider candidate species and especially those candidates that are petitioned or proposed for listing in environmental planning associated with agencies' activities. The mouse may be the most significantly affected species of concern for pond water management on the Site. The status of the Preble's Mouse in relation to its known range is yet to be determined, i.e., it is not yet fully known what this species requirements are for survival. Consequently, alternatives for action under this IM/IRA will be assessed with respect to the Preble's Mouse on their inherent capacity to evoke changes to ecological baseline relationships currently known to exist in Woman and Walnut Creeks. The basis of this premise is that the Preble's Mouse is known to be surviving and reproducing, at least to some minimal extent, under current ecological conditions. Further information should be available when the Biological Assessment is completed and the FWS returns its Biological Opinion as required under the ESA.

The Buffer Zone currently is home to the only known viable and self-sustaining population of the Preble's Mouse. The mouse has been observed at only four sites over the past 25 years. The mouse is known to inhabit Rock, Walnut, and Woman Creeks and is known to frequent the mixed shrub-grass habitats associated with main and tributary channels and riparian areas associated with each of these creeks. The mouse's exact distribution on the Site, along with its behavioral ecology, remains to be definitively ascertained.

According to a baseline biological characterization (DOE 1992), the original purchase of land for the plant in 1951 included 2,250 acres. Prior to development of the Site in the 1950s, the property was primarily used as rangeland. The majority of adjacent land has remained in rangeland through the years, although commercial, industrial, and residential development has been encroaching on wildlife habitats in the Colorado Front Range-Piedmont area at a phenomenal rate. Boulder and Jefferson Counties have purchased land near the Site and designated it as open space. County and privately held clay and gravel operations are conducted along the western edge of the Site. These operations may expand in the future potentially threatening surface water and groundwater quantities and quality that supports and sustains the sensitive habitats known to be used by the mouse.

The Site's Land Use Manual (Controlled Document 3-21500-GD-END-.01) states that additional Buffer Zone area purchased in 1974 was to be used to "minimize problems arising from the proximity of an industrial facility to a residential community." The document further indicates that the long-range goals set at the time of acquisition were to "preserve and enhance the natural ecological state of the land, upgrade the aesthetic appearance of the land, decrease erosion, and encourage vegetation growth to provide shelter for wildlife."

The mouse has been recorded in the following habitat types at the Site in approximate decreasing order of occurrence:

- Riparian shrubland (forming the deciduous streambank complex)
- Deciduous woodland (forming the deciduous streambank complex)
- Short shrubland
- Mesic mixed grassland
- Tall shrubland
- Short marsh
- Tall marsh
- Wet meadow
- Pond (impoundment) margin
- Range rehabilitation

The mouse has not yet been recorded on the Site in the xeric mixed grassland, ponderosa pine savannah, and the human structures biotopes.

Of primary concern for this IM/IRA in relation to the mouse is the ecological relationships of the plant and animal trophic level interactions that define functional ecologies important to the continued survival of the species. Part of the Pond IM/IRA process requires conducting a Biological Assessment under Section 7 of the ESA. DOE will assess these fundamental ecological relationships, to the extent practicable, for the mouse so that the IM/IRA selected alternative can be evaluated in terms of the levels of watershed systems and how they relate to the mouse. For the South Platte River basin, the following stream segments support fundamental aquatic community complexes that, in turn, sustain the terrestrial habitats that are important to this species. These geographical areas include:

- Big Dry Creek
- Smart Ditch
- Standley Lake
- Woman Creek
- Ponds C-2 and C-1 upstream through the Antelope Springs complex
- Kinnear Ditch
- Coal Creek
- Walnut Creek
- Great Western Reservoir
- McKay Ditch/Bypass
- No Name Gulch (Landfill Pond)
- North Walnut Creek (A-series ponds)
- South Walnut Creek (B-series ponds)
- Pond C-2 to A-4
- Broomfield Diversion Ditch
- Pond C-2 Pipeline

Fundamental questions regarding IM/IRA impacts to this species include:

1. Is habitat being destroyed by water management practices at a rate so slow that it is unnoticeable?

2. Do various flow regimes adversely affect mouse habitats?

A.2.5 Off-Site Impacts

In addition to on-site impacts, DOE must assess potential down-gradient/down-stream impacts from implementing the selected alternative for the IM/IRA. One potential impact that has been considered is the effect of operations at the Site upon flows in the South Platte River at the Nebraska state line. The concern is that reductions in flow due to human activity in the South Platte basin in Colorado has had a negative impact upon endangered species and, in particular, upon whooping crane habitat. The analysis of impacts attributable to the Site has led to the following conclusions. First, in its undeveloped condition prior to 1950, the hydrology of the Site was characterized by an unusually low rate of yield per unit area to the tributary water system, estimated at 1.4 percent of average annual precipitation. The amount of impervious area created through development of the Site has resulted in increased net yields of water from the Site. Second, industrial activity at the plant necessitated both a raw water supply, consisting of water imported to the South Platte basin, and a system of detention ponds for purposes of water quality monitoring prior to release which causes depletions to the native water yield from the site. As detailed in Chapter 7, the net additions of imported water to the tributary water system in the South Platte basin exceed the evaporative depletions to native water by a factor of approximately five. In conjunction with this ESA requirement, DOE will begin its efforts to achieve full compliance with the FWCA by using its FWCA compliance activities as a tool for achieving integrated environmental statutory compliance for potential on- and off-site impacts. The IM/IRA provides DOE an opportunity to begin work on FWCA compliance by addressing the Woman and Walnut Creek components of a future FWCA report.

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TABLE A-1
MAXIMUM MEAN DAILY FLOW AT GSO3
WALNUT CREEK AT INDIANA STREET

Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)
1992		1993		1994	
Jan 1-4	**0.608**	Jan 1-9	0.003	**Jan 1-8**	**n/a**
Jan 5-11	**0.825**	Jan 10-16	0.006	**Jan 9-15**	**n/a**
Jan 12-18	0.067	Jan 17-23	0.008	**Jan 16-22**	**n/a**
Jan 19-25	0.053	Jan 24-30	0.01	**Jan 23-29**	**n/a**
Jan 26 -Feb 1	0.03	Jan 31 - Feb 6	0.009	Jan 30 - Feb 5	
Feb 2-8	0.027	**Feb 7-13**	**0.393**	Feb 6-12	
Feb 9-15	**0.124**	**Feb 14-20**	**1.092**	Feb 13-19	
Feb 16-22	**0.657**	**Feb 21-27**	**1.005**	Feb 20-26	
Feb 23-29	0.077	Feb 28-Mar 6	0.02	Feb 27-Mar 5	
Mar 1-7	0.55	Mar 7-13	0.013	Mar 6-12	
Mar 8-14	**8.039**	Mar 14-20	0.01	Mar 13-19	0.006
Mar 15-21	**11.022**	**Mar 21-27**	**0.669**	**Mar 20-26**	**2.563**
Mar 22-28	**7.979**	**Mar 28-Apr 3**	**2.155**	**Mar 27-Apr 2**	**1.619**
Mar 29 - Apr	**4.48**	**Apr 4-10**	**2.548**	**Apr 3-9**	**1.676**
Apr 5-11	**1.829**	**Apr 11-17**	**3.876**	**Apr 10-16**	**2.219**
Apr 12-18	**1.88**	**Apr 18-24**	**2.507**	Apr 17-23	0.098
Apr 19-25	0.123	**Apr 25-May 1**	**1.111**	Apr 24-30	1.427
Apr 26-May 2	0.11	May 2-8	0.023	May 1-7	0.989
May 3-9	0.109	May 9-15	0.019	**May 8-14**	**1.329**
May 10-16	0.098	May 16-22	0.066	**May 15-21**	**1.792**
May 17-23	**0.245**	May 23-29	0.004	May 22-28	0.022
May 24-30	**2.03**	May 30-Jun 5	0.005	May 29-Jun 4	0.009
May 31- Jun 6	**2.428**	Jun 6-12	0.004	Jun 5-11	0.005
Jun 7-13	0.119	**Jun 13-19**	**1.931**	**Jun 12-18**	**0.412**
Jun 14-20	0.135	**Jun 20-26**	**1.229**	**Jun 19-25**	**1.353**
Jun 21-27	0.136	Jun 27-Jul 3	0.03	**Jun 26-Jul 2**	**1.43**
Jun 28-Jul 4	0.128	Jul 4-10	0.001	Jul 3-9	0.008
Jul 5-11	**0.383**	Jul 11-17		Jul 10-16	
Jul 12-18	**1.954**	**Jul 18-24**	**1.008**	**Jul 17-23**	**0.312**
Jul 19-25	**1.908**	**Jul 25-31**	**1.418**	**Jul 24-30**	**1.446**
Jul 26 - Aug 1	0.085	**Aug 1-7**	**1.544**	**Jul 31-Aug 6**	**1.08**
Aug 2-8	0.08	**Aug 8-14**	**1.462**	Aug 7-13	
Aug 9-15	0.086	Aug 15-21	0.011	Aug 14-20	
Aug 16-22	0.069	Aug 22-28	0.003	Aug 21-27	
Aug 23-29	0.064	Aug 29-Sep 4		Aug 28-Sep 3	
Aug 30-Sep 5	**0.709**	Sep 5-11		**Sep 4-10**	**n/a**
Sep 6-12	**0.296**	Sep 12-18		**Sep 11-17**	**n/a**
Sep 13-19	**2.954**	Sep 19-25		Sep 18-24	

TABLE A-1

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Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)
Aug 30-Sep 5	**0.709**	Sep 5-11		**Sep 4-10**	**n/a**
Sep 6-12	**0.296**	Sep 12-18		**Sep 11-17**	**n/a**
Sep 13-19	**2.954**	Sep 19-25		Sep 18-24	
Sep 20-26	**1.877**	Sep 26-Oct 2		Sep 25-Oct 1	
Sep 27-Oct 3	0.071	Oct 3-9			
Oct 4-10		Oct 10-16			
Oct 11-17		Oct 17-23			
Oct 18-24	**0.72**	Oct 24-30			
Oct 25-31	**0.831**	Oct 31-Nov 6			
Nov 1-7		**Nov 7-13**	**1.407**		
Nov 8-14	0.003	**Nov 14-20**	**1.385**		
Nov 15-21		**Nov 21-27**	**n/a**		
Nov 22-28		Nov 28-Dec 4			
Nov 29-Dec 5		Dec 5-11			
Dec 6-12	**0.003**	Dec 12-18			
Dec 13-19	**2.12**	Dec 19-25			
Dec 20-26	**2.115**	Dec 26-31			
Dec 27-31	0.001				

Note: Bold Indicates Periods of Discharge

TABLE A-2
POND WATER LEVEL FLUCTUATIONS SINCE 1991

	Extreme Conditions				Normal Operations				
Pond	Water Depth Max (ft)	Min (ft)	Water Surface Area Max (acres)	Min (acres)	Water Depth Max (ft)	Min (ft)	Water Surface Area Max (acres)	Min (acres)	(change)
C1	Flow Through				2.6	dry	0.48	dry	0.48
C2	17.5	6.5	5.25	0.7	13.3	6.5	2.8	0.7	2.1
A1	6	dry	0.67	dry	4.3	2.9	0.42	0.21	0.21
A2	11.3	6.5	1.7	0.55	11.7	8.4	1.8	0.9	0.9
A3	17		3.1	0.3	16.21	5.5	1.6	0.3	1.3
A4	24		6.75	0.8	21.3	9	5.3	0.8	4.5
B1	7	dry	1.15	dry	3.5	2.5	0.35	0.17	0.18
B2	7.5	dry	0.78	dry	5.8	3.6	0.47	0.22	0.25
B3	Daily Flow Through				2.7		0.12		
B4	Flow Through				2.8		0.18		
B5	28	11.8	5.1	0.6	22.5	11.8	3	0.6	2.4

TABLE A-3
MAXIMUM MEAN DAILY FLOW AT GSO1
WOMAN CREEK AT INDIANA STREET

Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)
1991		1992		1993		1994	
Jan 1 - 5		Jan 1-4		Jan 1-9		Jan 1-8	
Jan 6-12		Jan 5-11		Jan 10-16		Jan 9-15	
Jan 13-19		Jan 12-18		Jan 17-23		Jan 16-22	
Jan 20-26		Jan 19-25		Jan 24-30		Jan 23-29	
Jan 27 -Feb 2		Jan 26 -Feb 1		Jan 31 - Feb 6		Jan 30 - Feb 5	
Feb 3-9		Feb 2-8		Feb 7-13		Feb 6-12	
Feb 10-16		Feb 9-15		Feb 14-20		Feb 13-19	
Feb 17-23		Feb 16-22		Feb 21-27		Feb 20-26	
Feb 24-Mar 2		Feb 23-29		Feb 28-Mar 6	0.06	Feb 27-Mar 5	
Mar 3-9		Mar 1-7	2.782	Mar 7-13	0.149	Mar 6-12	
Mar 10-16		Mar 8-14	7.734	Mar 14-20	0.184	Mar 13-19	
Mar 17-23		Mar 15-21	6.646	Mar 21-27	0.072	Mar 20-26	0.043
Mar 24-30		Mar 22-28	2.475	Mar 28-Apr 3	0.56	Mar 27-Apr 2	0.188
Mar 31-Apr 6		Mar 29 - Apr 4	2.232	Apr 4-10	0.568	Apr 3-9	0.109
Apr 7-13		Apr 5-11	2.233	Apr 11-17	0.695	Apr 10-16	0.664
Apr 14-20		Apr 12-18	2.376	Apr 18-24	0.051	Apr 17-23	0.095
Apr 21-27		Apr 19-25	3.042	Apr 25-May 1	0.032	Apr 24-30	0.335
Apr 28-May 4	2.446	Apr 26-May 2	1.651	May 2-8	0.01	May 1-7	0.254
May 5-11	2.723	May 3-9	0.187	May 9-15		May 8-14	0.09
May 12-18	5.548	May 10-16	0.184	May 16-22		May 15-21	0.028
May 19-25	2.473	May 17-23	0.316	May 23-29		May 22-28	
May 26-Jun 1	n/a	May 24-30	2.001	May 30-Jun 5		May 29-Jun 4	
Jun 2-8	n/a	May 31- Jun 6	3.103	Jun 6-12		Jun 5-11	
Jun 9-15	1.614	Jun 7-13	1.382	Jun 13-19		Jun 12-18	
Jun 16-22	n/a	Jun 14-20	0.732	Jun 20-26		Jun 19-25	
Jun 23-29	0.006	Jun 21-27		Jun 27-Jul 3		Jun 26-Jul 2	
Jun 30-Jul 6	0.007	Jun 28-Jul 4		Jul 4-10		Jul 3-9	
Jul 7-13	0.002	Jul 5-11	0.002	Jul 11-17		Jul 10-16	
Jul 14-20	0.005	Jul 12-18		Jul 18-24		Jul 17-23	
Jul 21-27		Jul 19-25		Jul 25-31		Jul 24-30	
Jul 28 -Aug 3		Jul 26 - Aug 1		Aug 1-7		Jul 31-Aug 6	
Aug 4-10		Aug 2-8		Aug 8-14		Aug 7-13	
Aug 11-17		Aug 9-15		Aug 15-21		Aug 14-20	
Aug 18-24		Aug 16-22		Aug 22-28		Aug 21-27	
Aug 25-31		Aug 23-29		Aug 29-Sep 4		Aug 28-Sep 3	
Sep 1-7		Aug 30-Sep 5		Sep 5-11		Sep 4-10	
Sep 8-14		Sep 6-12		Sep 12-18		Sep 11-17	
Sep 15-21		Sep 13-19		Sep 19-25		Sep 18-24	
Sep 22-28		Sep 20-26	0.002	Sep 26-Oct 2		Sep 25-Oct 1	
Sep 29-Oct 5	0.001	Sep 27-Oct 3	0.003	Oct 3-9			
Oct 6-12		Oct 4-10		Oct 10-16			
Oct 13-29		Oct 11-17		Oct 17-23			
Oct 20-26		Oct 18-24		Oct 24-30			

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Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)
Oct 27-Nov 2		Oct 25-31		Oct 31-Nov 6			
Nov 3-9		Nov 1-7		Nov 7-13			
Nov 10-16		Nov 8-14		Nov 14-20			
Nov 17-23		Nov 15-21		Nov 21-27			
Nov 24-30		Nov 22-28		Nov 28-Dec 4			
Dec 1-7		Nov 29-Dec 5		Dec 5-11			
Dec 8-14		Dec 6-12		Dec 12-18			
Dec 15-21		Dec 13-19		Dec 19-25			
Dec 22-28		Dec 20-26		Dec 26-31			
Dec 29-31		Dec 27-31					

TABLE A-4
MAXIMUM MEAN DAILY FLOW AT GS01
WOMAN CREEK AT INDIANA STREET

Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)
1991		1992		1993		1994	
Jan 1 - 5		Jan 1-4		Jan 1-9		Jan 1-8	
Jan 6-12		Jan 5-11		Jan 10-16		Jan 9-15	
Jan 13-19		Jan 12-18		Jan 17-23		Jan 16-22	
Jan 20-26		Jan 19-25		Jan 24-30		Jan 23-29	
Jan 27 -Feb 2		Jan 26 -Feb 1	0.342	Jan 31 - Feb 6		Jan 30 - Feb 5	
Feb 3-9		Feb 2-8	0.307	Feb 7-13		Feb 6-12	
Feb 10-16		Feb 9-15	0.25	Feb 14-20		Feb 13-19	
Feb 17-23		Feb 16-22	0.195	Feb 21-27		Feb 20-26	
Feb 24-Mar 2		Feb 23-29	0.155	Feb 28-Mar 6	0.517	Feb 27-Mar 5	
Mar 3-9		Mar 1-7	1.284	Mar 7-13	0.335	Mar 6-12	
Mar 10-16		Mar 8-14	1.973	Mar 14-20	0.751	Mar 13-19	0.093
Mar 17-23		Mar 15-21	1.809	Mar 21-27	0.317	Mar 20-26	0.051
Mar 24-30		Mar 22-28	1.306	Mar 28-Apr 3	1.708	Mar 27-Apr 2	0.615
Mar 31-Apr 6		Mar 29 - Apr 4	1.187	Apr 4-10	1.779	Apr 3-9	0.368
Apr 7-13		Apr 5-11	0.507	Apr 11-17	1.612	Apr 10-16	1.361
Apr 14-20		Apr 12-18	0.601	Apr 18-24	0.589	Apr 17-23	0.232
Apr 21-27		Apr 19-25	0.461	Apr 25-May 1	0.337	Apr 24-30	1.298
Apr 28-May 4		Apr 26-May 2	0.282	May 2-8	0.199	May 1-7	0.791
May 5-11	1.042	May 3-9	0.115	May 9-15	0.103	May 8-14	0.264
May 12-18	1.567	May 10-16	0.084	May 16-22	0.308	May 15-21	0.1
May 19-25	0.922	May 17-23	2.202	May 23-29	0.068	May 22-28	0.011
May 26-Jun 1	0.331	May 24-30	3.414	May 30-Jun 5	0.004	May 29-Jun 4	0.009
Jun 2-8	2.505	May 31- Jun 6	4.062	Jun 6-12	0.01	Jun 5-11	
Jun 9-15	0.605	Jun 7-13	2.403	Jun 13-19	0.206	Jun 12-18	
Jun 16-22	0.209	Jun 14-20	1.379	Jun 20-26	0.034	Jun 19-25	
Jun 23-29	0.085	Jun 21-27	1.99	Jun 27-Jul 3	0.018	Jun 26-Jul 2	
Jun 30-Jul 6	0.265	Jun 28-Jul 4	1.006	Jul 4-10	0.021	Jul 3-9	
Jul 7-13	0.043	Jul 5-11	1.896	Jul 11-17	0.006	Jul 10-16	
Jul 14-20	0.017	Jul 12-18	0.02	Jul 18-24	0.013	Jul 17-23	
Jul 21-27	0.074	Jul 19-25	0.016	Jul 25-31	0.009	Jul 24-30	
Jul 28 -Aug 3	0.003	Jul 26 - Aug 1	0.015	Aug 1-7	0.005	Jul 31-Aug 6	
Aug 4-10	0.557	Aug 2-8	0.072	Aug 8-14	0.002	Aug 7-13	
Aug 11-17	0.132	Aug 9-15		Aug 15-21	0.011	Aug 14-20	
Aug 18-24	0.383	Aug 16-22		Aug 22-28	0.016	Aug 21-27	
Aug 25-31	0.065	Aug 23-29		Aug 29-Sep 4	0.017	Aug 28-Sep 3	
Sep 1-7	0.073	Aug 30-Sep 5		Sep 5-11	0.022	Sep 4-10	
Sep 8-14	0.04	Sep 6-12	0.002	Sep 12-18	0.013	Sep 11-17	
Sep 15-21	0.001	Sep 13-19	0.181	Sep 19-25	0.014	Sep 18-24	
Sep 22-28	0.003	Sep 20-26	0.006	Sep 26-Oct 2	0.013	Sep 25-Oct 1	
Sep 29-Oct 5	0.004	Sep 27-Oct 3	0.026	Oct 3-9			
Oct 6-12	0.003	Oct 4-10	0.02	Oct 10-16			
Oct 13-29	0.012	Oct 11-17		Oct 17-23			
Oct 20-26	0.009	Oct 18-24		Oct 24-30	0.013		
Oct 27-Nov 2	0.02	Oct 25-31		Oct 31-Nov 6	0.154		
Nov 3-9	0.092	Nov 1-7		Nov 7-13	0.077		

TABLE A-4

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Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)	Week	Maximum Mean Daily Flow (cfs)
Nov 10-16	0.015	Nov 8-14		Nov 14-20	0.162		
Nov 17-23	0.45	Nov 15-21		Nov 21-27			
Nov 24-30	0.241	Nov 22-28		Nov 28-Dec 4			
Dec 1-7		Nov 29-Dec 5		Dec 5-11			
Dec 8-14		Dec 6-12		Dec 12-18			
Dec 15-21		Dec 13-19		Dec 19-25			
Dec 22-28		Dec 20-26		Dec 26-31			
Dec 29-31		Dec 27-31					

APPENDIX B
NEPA ASSESSMENT

B.1 ENVIRONMENTAL IMPACT EVALUATION OF THE NO ACTION ALTERNATIVE

This appendix evaluates the environmental effects of the no action alternative. This alternative is defined as *maintaining pond management operations as currently practiced until such time as the Site mission changes prompt an alteration in such operations.* Alterations in the operations are considered proposed actions, and are not considered in this section.

This evaluation of the proposed actions considers the environmental issues of concern delineated pursuant to the National Environmental Policy Act (NEPA) in order to integrate program-level NEPA documentation into this Interim Measures/Interim Remedial Action (IM/IRA) Decision Document. Although some of these concerns have been addressed in previous sections, this section allows easy inclusion of NEPA values. This section also fulfills the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requirements to ensure that selected remedies protect the environment, as well as human health.

As noted in Chapter 1, an immediate threat to human health and the environment has not been associated with the subject ponds and any final remedial actions would be determined in conjunction with the Interagency Agreement schedule for Operable Units (OUs) 5, 6, and 7.

Overall, the purpose of pond management operations is to "...ensure that operations and activities are conducted to minimize impacts to human health and the environment, while achieving and maintaining compliance with current environmental laws and regulations." These operations involve diversions, stormwater runoff management, temporary holding actions, sampling, monitoring, treatment, and emergency spill control.

In evaluating environmental effects, both beneficial and adverse impacts relative to affected resources from the proposed pond management actions are considered. The resources evaluated are air quality, water quality, terrestrial and aquatic biota, threatened and endangered species, personnel exposure, cultural resources, wetlands and floodplains, commitment of resources, and cumulative impacts. Baseline conditions for these resources are also discussed in Chapters 2 and 6 of this document.

B.1.1 Air

The Site is subject to compliance with the Clean Air Act and 5400-series U.S. Department of Energy (DOE) Orders. Air emissions from current pond management operations are extremely limited. Overall, air quality benefits from the pond function of sedimentation. Contaminants present in the stormwater runoff and wastewater primarily settle on pond bottoms and are kept submerged by volume management so they do not become airborne.

B.1.2 Water

Under the no action alternative, the operation of the ponds does not *create* significant contaminants that adversely affect the water quality. Rather, the major function of the current pond management plan is to implement best management practices to achieve state water quality standards.

Pond management operations are conducted in order that water quality is maintained or improved. Detention of water in the pond system for a designated period allows sedimentation to occur. Sedimentation effectively settles potentially-contaminated suspended solids, removing them from the water column for as long as the sediments are not resuspended by disturbance (DOE 1980). Transuranic radionuclides are highly insoluble and tend to bond to soil particles (DOE 1980); they are, therefore, removed from the water column via sedimentation. Through volume management, potentially-contaminated sediments are kept covered with water so that sediments are not exposed to wind erosion.

The no action alternative does not involve significant alterations in operations that may result in adverse effects which presently do not exist (e.g., construction activities in certain pond areas may resuspend sediments within the water column; a pond closure or complete discharge may expose sediments to wind erosion).

Sampling has shown occasional plutonium concentrations greater than the Segment 4 Standards in Pond C-2. Since it is possible to transfer Pond C-2 water by pipeline to either Pond B-5 or Pond A-4, transferring may have an adverse effect on water quality in Pond B-5 or Pond A-4 . However, a transfer of this type is limited to emergency operations only. Typically, volume management on Pond C-2 involves discharge to the Broomfield Diversion Ditch only after sampling shows state water quality standards have been met and after obtaining concurrence from the Colorado Department of Public Health and Environment (CDPHE) and current NPDES permit bypass approval from the U.S. Environmental Protection Agency (EPA).

Use of Ponds A-1, A-2, B-1, and B-2 for spill containment is an emergency measure. Tanks, pipes, material transfers, and other potential origins of a spill are provided with secondary containment or are subject to measures set forth in the Spill Prevention Control Countermeasures and Best Management Practices Plan and related documents. The impact on water released off-site is not expected to be detrimental since these ponds can be isolated from the rest of the surface water management system and the management system can administer effective methods of treating any water contaminated by a spill.

Discharge operations, also a concern, are implemented only after sampling shows that state water quality standards have been met and after obtaining CDPHE concurrence. In addition, the outlet works at most ponds are no longer used for discharge because their use would pull water off the bottom of the ponds. This action has the potential of resuspending sediments from the bottom of the pond into the discharge. Since 1990, discharge operations have been conducted with a suspended intake line attached to a pump that discharges water from the surface and mid-level portions of the ponds.

B.1.3 Personnel Exposure

Applicable pathways are inhalation of volatilized contaminants, dermal absorption of contaminants, and direct exposure to ionizing radiation. No produce or livestock are grown on-site, and there is no fishing in surface water ponds, so ingestion of contaminated food is not an applicable pathway. Ingestion of contaminated water is not applicable because water is provided from a municipal supply on-site.

A maximally exposed worker would be located adjacent to the ponds. The workers that are currently adjacent to the ponds for the maximum time of exposure are engaged in pumping Pond B-5 water to Pond A-4. The inorganics and metals, and all radionuclides except tritium, will not volatilize. The only contaminants that could be released to the atmosphere via volatilization, and therefore be a potential pathway for personnel exposures, are the volatile organics and tritium.

Dermal absorption could potentially occur as a result of direct dermal contact with pond water through sampling operations. After the initial contact, a fraction of each contaminant could migrate through the skin and contact the bloodstream. This is a low frequency occurrence because, even though sampling is done daily during discharge conditions, pond water contact is unusual during sampling because samplers wear protective gloves. The sampling typically results in a possible exposure of less than an hour. The skin forms an effective barrier so contaminants are largely excluded from bloodstream contact.

The radionuclides in the ponds will produce particles as they decay. Some of these particles will be emitted from the ponds and could impinge upon any receptor in the immediate vicinity. A worker could experience this pathway while in the immediate vicinity of the ponds. To produce an effect, these particles would have to pass through an amount of water equivalent to the radionuclides' depth, the water surface tension, a distance of air between the pond surface and the receptor, and, lastly, the receptor's skin. The majority of radiation will be alpha particles, which will not penetrate the full water-air-skin pathway. Clothing will cover most of the worker, and will provide an additional amount of protection, further reducing the expected exposure.

For all pathways, the personnel exposure due to pond water contaminants will be governed by specific programs designed to protect employees. These programs include Industrial Hygiene, Nuclear Safety Engineering, Occupational Safety, and Radiological Health. No operations will take place unless the safety programs have reviewed those operations and determined that they meet all applicable safety requirements.

This oversight is accomplished through the use of procedural compliance. All operations involving hazardous and/or radioactive materials will be governed by procedures, and these procedures will be reviewed by the applicable safety organizations prior to implementation. By this mechanism, the operations procedures, as well as Conduct of Operations, Integrated Work Control Program, and Conduct of Engineering Manual procedures will be used to ensure a safe working environment.

B.1.4 Cultural Resources

A cultural resource inventory for the Site was completed in July 1991 (DOE 1991a). The study located six previously-identified historic sites and identified 45 cultural resources on the Site The report concluded none of the sites was eligible for the National Register of Historic Places, and recommended no further work be done on any of the cultural resources. The Colorado State Historic Preservation Officer concurred with that recommendation.

In addition, current pond management operations do not involve any activity, such as construction, that would unearth any undiscovered historic sites. Therefore, it is not anticipated adverse effects to historic properties would occur due to implementation of current pond management.

B.1.5 Wetlands and Floodplains

The following section discusses the presence, status, and potential impact on wetlands and floodplains relative to current pond management practices.

B.1.5.1 Wetlands

At the time this document was being prepared, a formal U.S. Army Corps of Engineers (USACE) wetland delineation of the Site had not been completed. Current wetland areas have been classified according to the U.S. Fish & Wildlife Service Classification System and are described in *Wetlands Assessment, Rocky Flats Plant Site.*

According to this assessment, the Walnut Creek drainage wetlands include palustrine emergent wetlands and palustrine scrub-shrub in and along lower gradient stream segments and around the perimeter of ponds. A few palustrine flat wetlands (seeps) are found on the north-facing slope downstream of Pond B-5. The A- and B-series ponds and the Landfill Pond, all in Walnut Creek, contain permanent water.

Wetland area along the Woman Creek drainage includes palustrine emergent wetlands, palustrine scrub-shrub wetlands, palustrine flat wetlands, and areas of open water. Palustrine emergent wetlands are found along the stream channels, in the South Interceptor Ditch, and around the perimeter of the ponds. Areas of palustrine wetlands along stream channels and around the perimeter of ponds that are dominated by willows and/or leadplant are classified as scrub-shrub wetlands. Just north of Pond C-2, smaller palustrine flat wetland areas occur.

According to the USACE, palustrine wetlands are non-tidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses and lichens. Emergent vegetation designates erect, rooted, herbaceous vegetation. While not ecologically-unique, the palustrine wetlands associated with the pond system are valued for their various physical, chemical, and biological processes/attributes (functions), which may include wildlife diversity/abundance, aquatic diversity/abundance, sediment stabilization, and nutrient removal/transformation.

Wetlands that currently exist around the pond areas have developed as a result of the operation of the pond system since it was initiated in the early 1950s. Although these wetlands developed around manmade features, they do add to the total area of wetlands at the Site. Pond management operations are in compliance with wetland protection provisions of the Clean Water Act (CWA).

Basically, impacts to wetlands in the pond areas are due to volume fluctuations. An increase in volume may drown some species of wetland vegetation, depending on time submerged. Conversely, a decrease in volume may dry some species. Actual wetland area may increase or decrease over short periods of time. As this vegetation is affected, wildlife using it as habitat or foodstuffs will, in turn, be affected.

These impacts are not necessarily adverse or beneficial. Wetlands typically pass through various ecological successional stages as physical conditions change. The duration of these stages can last years or lifetimes. Many types of wetlands are not, in fact, climax communities, but interim successional stages (Hammer 1992).

It is likely natural wetlands occurring along the streams would also represent interim stages, since both Walnut Creek and Woman Creek are ephemeral. Current pond management involves volume manipulation of the ponds. Water levels are maintained at between 20 to 50 percent; therefore, wetlands are unlikely to completely dry out. Therefore, current operations do not produce adverse impacts on surrounding wetlands.

B.1.5.2 Floodplains

The ponds are all located within the 100-year floodplain, as classified by the USACE. The function of pond management is an acceptable land use within such a floodplain. In general, however, flood handling capability and the intended functions of the pond system are not complementary; both cannot be accomplished simultaneously with optimal results.

With regard to flood handling capability, the 100-year, 6-hour storm event is currently used as the design and/or modeling criteria in designing or evaluating drainage plans and structures. This criterion is used because it postulates a shorter event of greater intensity, which tends to produce the greatest problems with drainage systems. Upgrades and additions to the drainage system implemented since approximately 1979 have used this design criteria.

The terminal ponds are designed to handle 100-year, 6-hour storm events. The calculated volume of runoff from a 100-year, 6-hour event at the subject terminal ponds is correlated with actual pond design volumes:

Pond	Calculated Volume of Runoff	Actual Pond Design Volumes
A-4	21.3 million gallons	32.5 million gallons
B-5	23.6 million gallons	24.0 million gallons
C-2	9.3 million gallons	22.7 million gallons

A significant volume of runoff from a 100-year, 6-hour storm event would be carried *around* the Site core area by the McKay Diversion Structure. Almost 100 million gallons of runoff would flow through this bypass, thereby not entering the pond system.

Although the pond design volumes are adequate to handle a significant storm event, the volume margins are reduced when pond functions are being implemented. As described previously, one of the primary functions of the pond management system is to control discharge such that downstream water levels are not significantly altered; the Site water must be returned to the South Platte drainage basin (according to the contract with the Denver Water Board). Also, the pond system controls effluent which may contain contaminants, holding water so sedimentation and sampling can occur.

In order to maintain volume levels that will accommodate these two functions, as well as emergency spill containment, the current pond management procedures (e.g., transfers, off-site discharge) are calculated to keep pond volumes below a maximum of 50 percent. In addition, ponds are managed to retain pond volumes at approximately a 20-30 percent minimum to keep sediments covered.

Drainage structures located upstream of the terminal ponds are currently not capable of handling a 100-year, 6-hour storm event. A primary reason is lack of maintenance. Wetland vegetation has grown in front of inlets, ditches contain sediment, and culverts are damaged. Certain maintenance is routine and categorically excluded from the NEPA process. However, an Environmental Assessment is currently being prepared which addresses surface water structures maintenance at the Site taking place in floodplain and wetland areas. If a Finding of No Significant Impact is approved, it is expected that maintenance in such areas will begin.

B.1.6 Commitment of Resources

The fundamental resource involved in the current pond management activities is water. Operation of the ponds does not significantly alter downstream water quality, flow patterns, and/or volumes. Discharge flow rates are controlled such that the integrity of downstream conveyance or containment structures is not compromised.

Some water evaporates and is potentially lost from the South Platte drainage basin. Most of the water intake is returned to the system as discharge. Annual raw water intake for the Site in 1992 was about 118,989,000 gallons (Padgett 1993). This gallonage represents both water going through the raw water system (process source) and through the water treatment system (potable source). According to the *Rocky Flats Plant Site Environmental Report: January Through December 1992*, total discharge for 1992 was 178,345,000 gallons.

Raw water used in the process system is sometimes recycled within the system and some evaporates through the cooling towers. The remaining amount, in addition to all of the potable water collected in the sanitary sewer system, goes through the wastewater treatment plant (WWTP). Total discharge from the WWTP for 1992 was 51,902,000 gallons. Surface water runoff from precipitation accounts for the additional discharge.

In addition to water resources, a certain amount of energy is expended to operate, for example, discharge pumps, spray evaporation equipment, and associated vehicles for personnel. Energy is also expended indirectly in the production of goods required for water treatment, discharge, and monitoring.

An unspecified number of labor hours are utilized to conduct all of the management operations related to the ponds. This would include the various sampling, monitoring, and documentation activities necessary for compliance.

B.1.7 Cumulative Impacts

This evaluation of no action considered environmental issues of concern delineated pursuant to the NEPA in order to integrate program level-NEPA documentation into this document. The current pond management plan (the no action alternative) operates the pond system such that related impacts to potentially affected resources are negligible.

In considering environmental impacts from the current pond management operations, there are certain external forces that indirectly affect the impacts noted in this report. As development continues around the undeveloped buffer zone (i.e., potentially making off-site wildlife and vegetation habitat unavailable), an undue burden may be placed on this buffer zone by wildlife and/or vegetation "looking for a place to live." This condition could ultimately tax the buffer zone ecosystem thereby increasing the significance of current impacts or currently non-significant impacts.

B.2 ENVIRONMENTAL IMPACT EVALUATION OF THE SELECTED ALTERNATIVES

The alternatives discussed in Chapter 6 represent changes in current operations and are termed "proposed actions" for this environmental analysis. The proposed actions analyzed for this section involve variations of two options–batch discharge and controlled detention and discharge.

This evaluation of the proposed actions considers the environmental issues of concern delineated pursuant to NEPA in order to integrate program-level NEPA documentation into this document. Although some of these concerns have been addressed in previous sections, this section allows easy inclusion of NEPA values. This section also fulfills CERCLA requirements to ensure that selected remedies protect the environment, as well as human health.

Actions proposed through this document are intended to be interim actions in effect until completion of relative environmental restoration (±5 years). Potential contaminants of concern have been noted in this document, although formal characterization of OUs 5, 6, and 7 has not been completed. Therefore, the effects of the proposed actions on resources are evaluated in this section based on the objectives of pond management and the focus of the subject interim action. Overall, the purpose of pond management operations is to "...ensure that operations and activities are conducted to minimize impacts to human health and the environment, while achieving and maintaining compliance with current environmental laws and regulations." These operations involve diversions, stormwater runoff management, temporary holding actions, sampling, monitoring, treatment, and emergency spill control.

In evaluating environmental effects, both beneficial and adverse impacts relative to affected resources from the proposed pond management actions are considered. The resources evaluated are air quality, water quality, terrestrial and aquatic biota, threatened and endangered species, personnel exposure, cultural resources, wetlands and floodplains, commitment of resources, and cumulative impacts.

B.2.1 Air

Proposed actions with the potential to affect air quality involve re-initiation of spray evaporation and spray irrigation operations, initiation of aeration operations at terminal ponds, and proposed use of combustion engines as part of treatment or pumping activity. In addition, those proposed actions involving construction have the potential to affect air quality by resuspending pond sediments.

Re-initiation of spray evaporation activity may create air emissions. Volatile organics may be emitted during actual spray procedures and nitrogen oxide emissions may arise from diesel-fueled generators and water pumps.

Previous spray evaporation operations took place from May to September, during daylight hours only, seven days a week, evaporating approximately 5,000 gallons per day at each location. Estimated actual water evaporation at each location was 900,000 gallons annually. Analytical sampling for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) was conducted at both locations in the spring of 1993. These samples were analyzed by General Laboratory, an EPA-registered laboratory.

Results from this analysis were used by the Site's Air Quality personnel to project total emissions from spray evaporation operations. Maximum concentration levels of each compound were added together. Emissions were calculated based on the total concentration level of the compounds and pertinent operating parameters. Estimated maximum VOCs emissions for the Landfill Pond and Pond A-2 were found to be as follows:

Landfill Pond	13 pounds/year
Pond A-2	11 pounds/year

Colorado air quality regulations require reporting if total VOCs emissions exceed 2,000 pounds per year. In addition, several compounds listed in the sampling data are also "non-criteria reportable pollutants" as set forth in the regulations. These compounds must be reported if they exceed 250 pounds per year individually. The 250 pounds per year de minimis level is based on a reporting scenario established in Appendix A of the Colorado Air Quality Control Regulation No. 3 that takes into account the distance of the source from the property boundary.

Re-initiation of spray evaporation and/or spray irrigation operations has the potential to more than double the air emissions previously generated by pond management. However, emissions doubled from these two operations are likely to be below reporting levels and, therefore, would not contribute materially to cumulative total emissions at the Site.

Construction activities associated with dam upgrades and system installation could disturb pond sediments, allowing pond sediments to dry and become airborne. Airborne pond sediments are of concern because of the potential for contaminated sediments to be dispersed off-site by wind or to contaminate an area on-site currently considered clean. To ensure such activities do not adversely impact the environment, the Plan for the Prevention of Contaminant Dispersal (PPCD) was mandated by the Interagency Agreement (IAG) and finalized in late 1991. The PPCD is applicable to intrusive field activities conducted as part of IM/IRA actions. It provides project-specific procedures for managing even minor excavations, such as those noted above. The PPCD procedures would be integrated into any final plans concerning construction activities associated with pond management.

A certain amount of vehicular emissions and fugitive dust is associated with construction equipment. Because construction activity produces fugitive dust that remains near ground level, air quality impacts will likely be limited to the Site or areas in close proximity to the facility. Fugitive dust can be mitigated through a combination of control technology and generally accepted work practices. Vehicular emissions are controlled through Title II of the Clean Air Act.

Finally, any increase in the use of generators for discharge and treatment activities may occur with implementation of the proposed actions. Although minimal in amount, emissions from these generators are of concern if, when added to existing nitrogen oxide emissions at the Site, the proposed actions cause the nitrogen oxide emissions total to exceed the threshold. At that point, the Site may be required to prepare an Air Pollutant Emission Notice (APEN) or Prevention of Significant Deterioration Permit (PSD), unless otherwise directed by EPA or CDPHE.

B.2.2 Water

The source of any low concentration of contaminants entering the ponds results from Site activities. As with the no action alternative, a major function of the proposed actions is to provide best management practices for achieving water quality standards. Given this purpose, the proposed actions would have a positive impact on water quality.

The waters discharged off-site consistently meet or exceed the quality required by Segment 4 standards. Proposed monitoring, treatment, and transfer actions would improve the quality of waters handled on-site within the pond system. Detention of water in the pond system for a designated period allows sedimentation to occur. Sedimentation effectively settles potentially contaminated suspended solids, removing them from the water column for as long as the sediments are not resuspended by disturbance. Through volume management, sediments remain covered with water and are not exposed to wind or water erosion.

Impacts to surface and groundwater quality (through resuspension of sediments) could occur during structural modification of dams and/or system installation. Resuspension of sediments into the water column would impede the scheduling for discharges and transfers, which could have an adverse impact on water quality and associated resources if an emergency occurred. For this reason, all final plans for construction activities associated with dam upgrades and system installation would be preceded by a consultation with the OU Project Manager. Procedures from the *Watershed Management Plan for Rocky Flats* (WMP) would also be integrated into any final plans.

The proposed action of retaining use of Ponds A-1, A-2, B-1, and B-2 for spill control (an emergency measure to provide backup to upgradient secondary containment) is not anticipated to have an adverse impact on water quality since the intent of the operation is to prevent uncontrolled downstream discharge of contamination.

B.2.3 Personnel Exposure

Members of the public could be affected by airborne releases of VOCs from spray evaporation of pond water. The potential risk of this activity was evaluated using, as an example, water from Pond B-2 (EG&G 1992). This analysis shows that both carcinogenic and non-carcinogenic risks are far below levels of concern. Given that chemical concentrations are of a similar order of magnitude at other ponds, the risks associated with spray evaporation at all ponds would be comparably low.

The analysis models a release of contaminants due to spray evaporation of Pond B-2. The contaminants volatilize from pond water, travel to an off-site receptor in a Gaussian plume, and are then inhaled by the receptor. The results of the analysis are that the carcinogenic risk due to spray evaporation of Pond B-2 is 2.7E-10, and the hazard index is 4.5E-7. Since hazard indices below 1.0 and risks below the range of 1.0E-4 to 1.0E-6 are considered acceptable, the risk and hazard calculated here are very low, as stated above.

Assumptions used to develop this analysis were as follows:

1. The evaporator will be operated for 10 hours per day, 125 days per year, for 30 years, at an average flow rate of 1,000 gallons per minute.

2. The wind speed will be 4.7 meters per second, and the Pasquill stability class will be D.

3. The receptor will be at a distance of 1,600 meters from the source.

4. The receptors breathing rate is 20 m^3 per day.

5. The receptor has a mass of 70 kilograms.

6. The analytical suite of contaminants that was tested for was a list of 34 volatile organics, of which four were determined to be present: methylene chloride, acetone, 1,2-dichloroethene, and trichloroethane. These four chemicals were evaluated in the analysis.

B.2.4 Cultural Resources

A formal cultural resource inventory was conducted at the Site. Historic properties were not found within proximity of the ponds. Thus, adverse impacts to cultural resources from the proposed actions are not anticipated (DOE 1991a).

However, construction activities, such as excavation and trenching, have the potential to unearth previously undiscovered sites. In the event that unknown properties are identified during a construction activity, the Colorado State Historic Preservation Officer would be consulted prior to continuation of construction, as required by the Section 106 process of the National Historic Preservation Act.

B.2.5 Wetlands and Floodplains

The following section discusses the potential impact the proposed actions may have on the wetlands and floodplains of the Site.

B.2.5.1 Wetlands

Wetlands that currently exist around the pond areas have developed as a result of the operation of the pond system since it was initiated in the early 1950s. Although these wetlands developed around manmade water features, they do add to the total area of wetlands at the Site and may be subject to the wetland protection provisions of the CWA. The most recent federal policy regarding wetlands supports the goal of "no net loss," which applies to activities that are regulated under the CWA (e.g., dredge or fill operations).

A formal delineation of wetlands at the Site has been initiated by the USACE. Subsequent to completion of this delineation, a comprehensive wetland management program for the Site would be developed and adopted by DOE. Until these two activities are complete, any proposed actions (e.g., minor excavations and surface disturbances) would be analyzed in an initial consultation with EPA and the Site's Ecology and Watershed Management personnel. This consultation would determine what, if any, procedures or mitigation are required.

Those proposed actions involving construction activities within wetland areas have the potential to destroy these wetlands. A consultation with EPA and the Site's Ecology and Watershed Management personnel would be required to ensure that methods and procedures complied with the wetland protection provisions of the CWA. [Regarding impacts on wetlands, the size of a wetland is not the basis of its significance. Alteration of a small wetland area may prove significant depending upon its type, location, and prevalence.]

Volume management and associated actions (i.e., spray evaporation, recycling, and downstream discharges) may affect wetland areas and type through ongoing fluctuations. An increase in volume may drown some species of wetland vegetation, depending on the length of submersion. Conversely, a decrease in volume may dry some species. Some spray evaporation operations may create artificially supported wetlands. Actual wetland areas may increase or decrease over short periods of time.

As this vegetation is affected, wildlife using it as habitat or a food source will, in turn, be affected. These effects are not necessarily adverse or beneficial based on ecological succession.

B.2.5.2 Floodplains

The ponds are all located within the 100-year floodplain, as classified by the USACE. The function of pond management is an acceptable land use within such a floodplain. Flood handling capability and the intended function of the pond system are not complementary, in that both cannot be accomplished simultaneously with optimal results.

While the terminal ponds and most of the diversion and interceptor ditches are designed to handle a 100-year, 6-hour storm event, certain drainage structures located upstream of the ponds are not. Some structures predating 1980 used 25-year storm event design criteria and require upgrading to adequately handle flows. Increasing the capability of the bypasses to carry the 100-year, 6-hour storm event would lessen the likelihood that flood water would: (1) inundate (and thereby negate the functions of the spill control ponds), and (2) prevent or minimize soil erosion due to flood washing.

The construction of upgrades and/or replacements to bring the stormwater system up to the 100-year, 6-hour storm event design criteria are addressed in the *Environmental Assessment, Surface Water Structures Maintenance at Rocky Flats*. Preparation of this environmental assessment (EA) is concurrent with the *Pond Water Management IM/IRA Decision Document*. Tentatively, the EA would apply to routine maintenance activities and "like replacement within a wetland." Preliminary details and specifications for the specific projects associated with these proposed actions would be submitted to the Site Design Review for a determination of whether or what additional compliance with NEPA is required.

B.2.6 Commitment of Resources

As with the no action alternative, other resources would be committed to implement the proposed actions. These include displacement or temporary loss of vegetation due to construction activities and an unspecified number of labor hours.

In addition, a certain amount of energy is expended to operate discharge pumps, spray evaporation equipment, and associated vehicles for personnel. The proposed installation of additional spray evaporation, spray irrigation, recycling and monitoring equipment, and structural modification of the dams would incrementally increase the energy expended to conduct pond management. Relative to plant-wide energy use, this increase is minimal.

B.2.7 Cumulative Impacts

This evaluation of the proposed actions considered environmental issues of concern delineated pursuant to NEPA in order to integrate program-level NEPA documentation into this IM/IRA Decision Document.

Impacts to affected resources from these proposed actions are anticipated to be negligible if mitigative measures are taken. These mitigative measures would be developed based on the recommended consultation with the appropriate regulatory personnel and the Site's NEPA specialists regarding site-specific and project-specific plans.

Use of spray evaporation and spray irrigation operations will create the potential for air emissions. However, emissions from these operations would still be below reporting levels and, therefore, would not contribute materially to cumulative total emissions at the Site.

Construction activities associated with dam upgrades and system installation could disturb pond sediments, allowing pond sediments to dry and become airborne. To ensure that such activities do not adversely impact the environment, the PPCD procedures would be integrated into any final plans concerning construction activities associated with pond management.

An increase in the use of generators for discharge and treatment activities is likely with implementation of the proposed actions. These emissions would be minimal in amount.

The source of any low concentration of contaminants potentially affecting water quality of the ponds is from activities at the Site. As with the no action alternative, the major function of the proposed actions is to provide best management practices for achieving state water quality standards. Given this purpose, the proposed actions would have a positive impact on water quality.

Segment 4 standards are consistently met or exceeded for waters discharged off-site. Proposed monitoring, treatment, and transfer actions would improve the quality of waters handled on-site within the pond system.

Impacts to surface and groundwater quality could occur during dewatering for excavations and during installation of wells through resuspension of sediments. All final plans for construction activities associated with dam upgrades and system installation should be preceded by a consultation with the OU Project Manager. Procedures from the WMP should also be integrated into any final plans.

The proposed action of retaining use of Ponds A-1, A-2, B-1, and B-2 for spill control (an emergency measure to back-up upgradient secondary containment) is not anticipated to have an adverse impact on water quality.

A formal cultural resources inventory was conducted at the Site. Historic properties were not found within proximity of the ponds. Thus, adverse impacts to cultural resources from the proposed actions are not anticipated. However, construction activities, such as excavation and trenching, have the potential to unearth previously undiscovered sites. In the event that unknown properties are identified during construction activity, the Colorado State Historic Preservation Officer would be consulted prior to continuation of construction.

Wetlands that currently exist around the pond areas have developed as a result of the operation of the pond system since it was initiated in the early 1950s. Volume management and associated actions (i.e., spray evaporation, spray irrigation, recycling, and downstream discharges) affect wetland areas and type through ongoing fluctuations. Actual wetland areas may increase or decrease over short periods of time. These effects are not necessarily adverse or beneficial based on ecological succession.

Several of the proposed actions involve construction activities within wetland areas that have the potential to destroy these wetlands. A consultation with EPA and the Site's Ecology and Watershed Management personnel would be required to ensure that methods and procedures complied with the wetland protection provisions of the CWA.

The ponds are all located within the 100-year floodplain, as classified by the USACE. The function of pond management is an acceptable land use within such a floodplain. Flood handling capability and the intended function of the pond system are not complimentary, in that both cannot be accomplished simultaneously with optimal results. However, proposed actions are intended to address the capability of the stormwater system and ponds to carry the 100-year, 6-hour storm event. This would have a beneficial effect on the adjacent environment.

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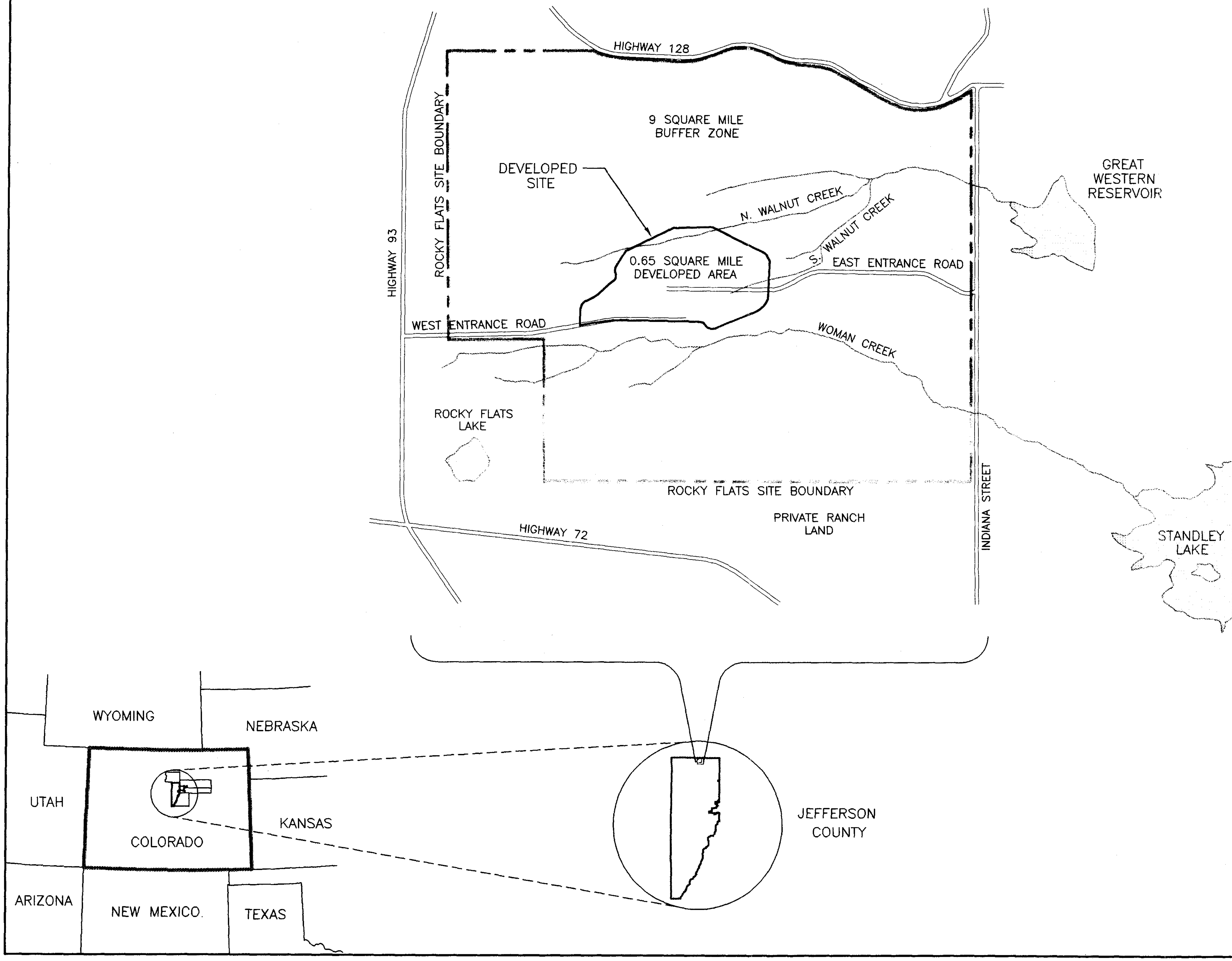

FIGURE 1-1
FACILITY LOCATION

PREPARED FOR:
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

TITLE:
ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
POND WATER MANAGEMENT
IM/IRA DECISION DOCUMENT

PROJ. NO.	901-004.45A	DWG. NO.	-	SHEET
DESIGN BY	-	CHECKED	-	-
DRAWN BY	KAL	APPROVED	-	OF
DATE	SEPTEMBER 30, 1994	SCALE	NOT TO SCALE	-

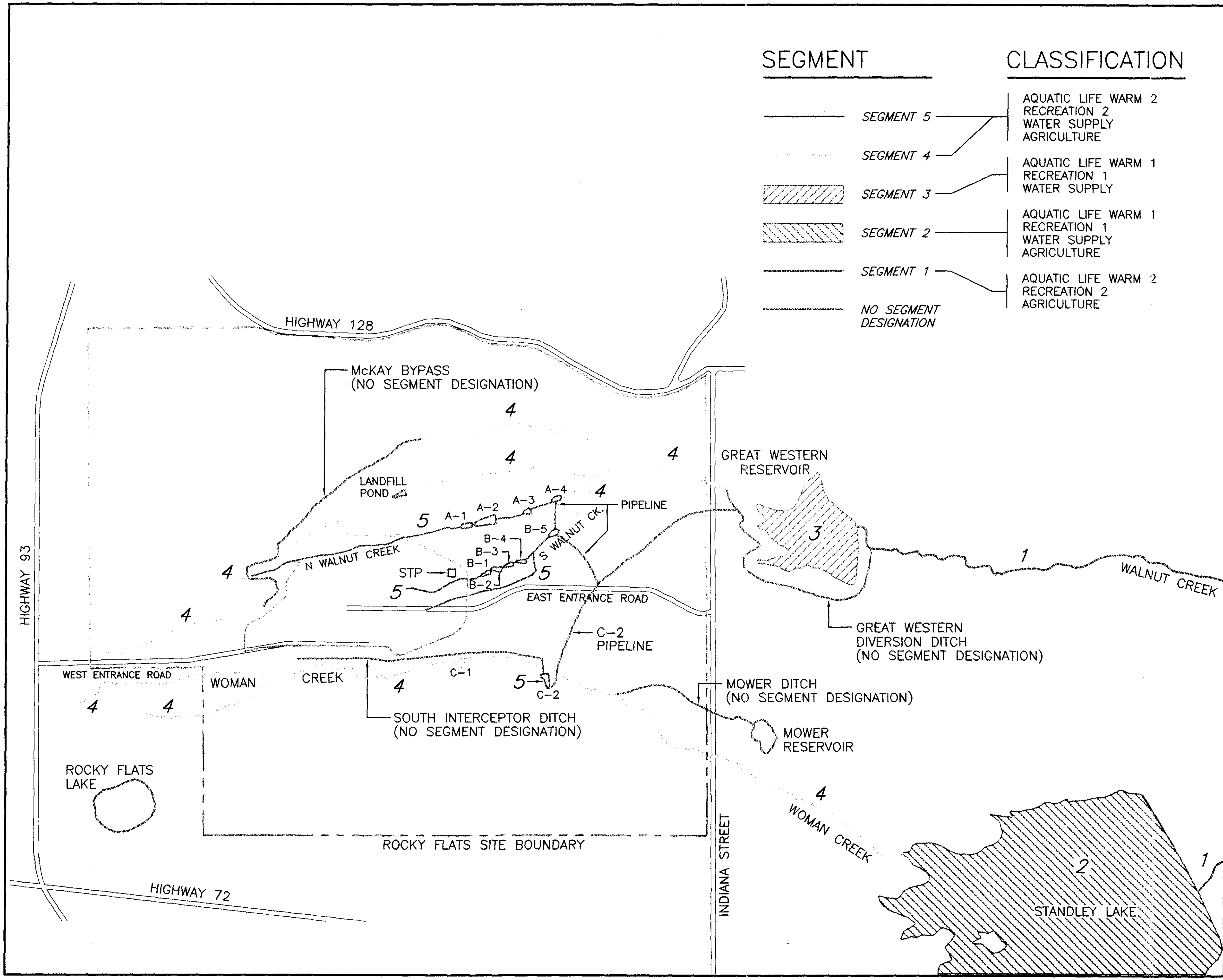

FIGURE 1-2
DRAINAGE PONDS AND STREAM SEGMENTS

MAP LEGEND

SEE SEGMENT/CLASSIFICATION TABLE THIS FIGURE

PREPARED FOR:
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
GOLDEN, COLORADO

TITLE:
ROCKY FLATS
ENVIRONMENTAL TECHNOLOGY SITE
POND WATER MANAGEMENT
IM/IRA DECISION DOCUMENT

PROJ. NO.	901-004.45A	DWG. NO.	-	SHEET
DESIGN BY	-	CHECKED	-	-
DRAWN BY	KAL	APPROVED	-	OF
DATE	SEPTEMBER 30, 1994	SCALE	1"=3000'	-

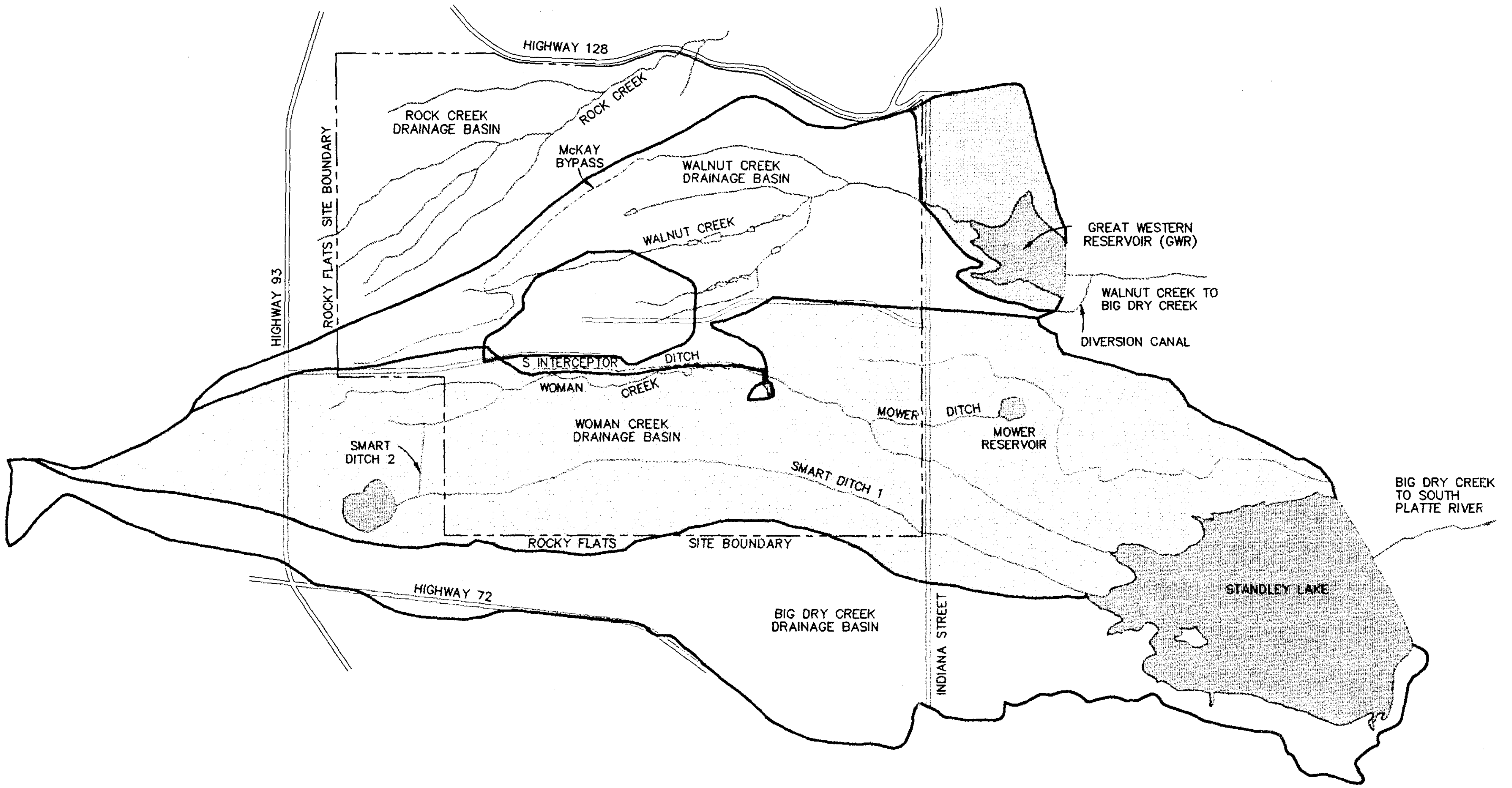

FIGURE 2-1
DRAINAGE BASINS

MAP LEGEND

WALNUT CREEK BASIN (DIVERTED AROUND GWR)

GREAT WESTERN RESERVOIR BASIN (GWR)

WOMAN CREEK BASIN

BIG DRY CREEK BASIN

DIVERSIONS

NORTH

GRAPHIC SCALE

1 1/2 1/4 0 1/4 1/2 1

SCALE IN MILES

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GOLDEN, COLORADO

TITLE:

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DATE	SEPTEMBER 30, 1994	SCALE	1"=5000'	–

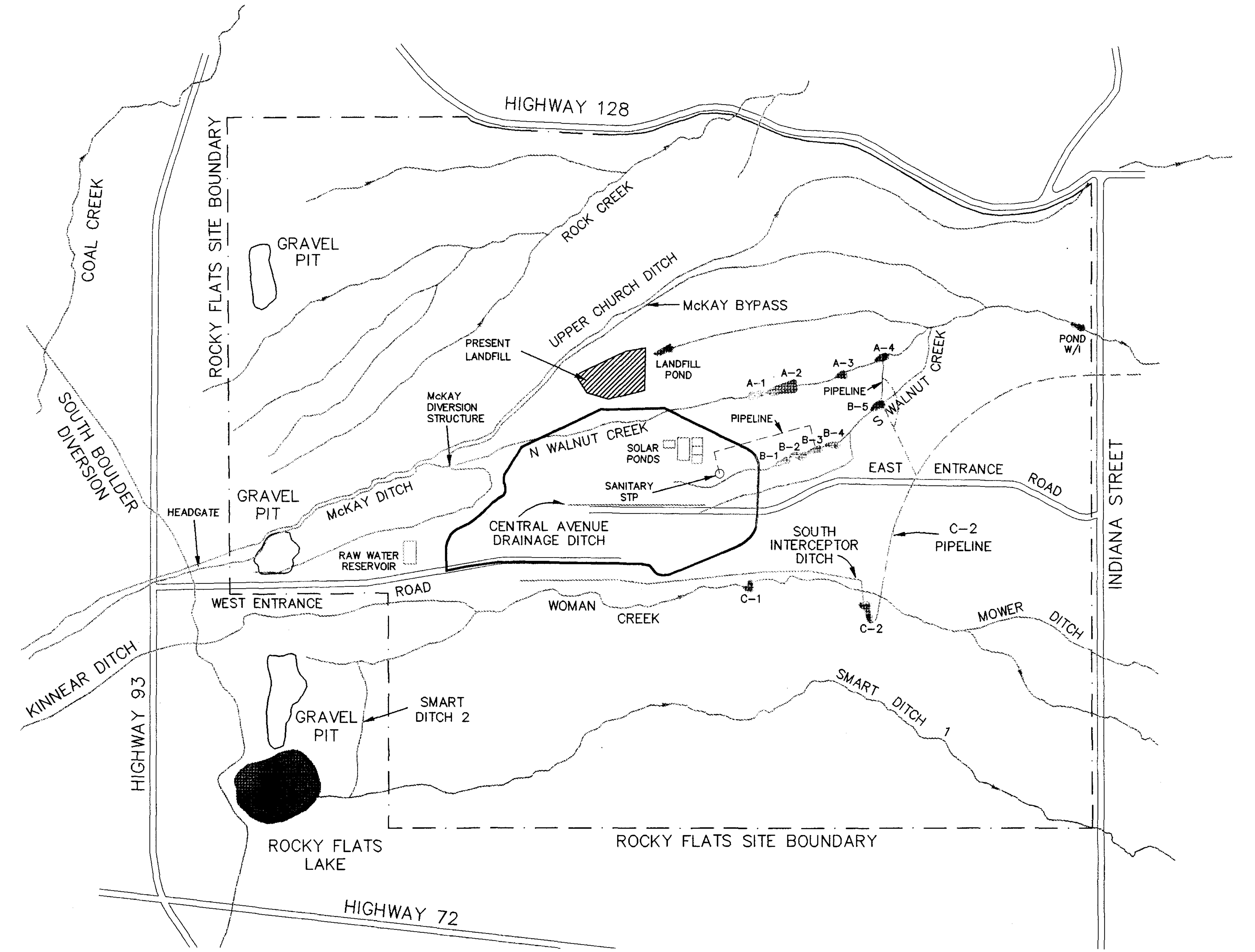

FIGURE 2-2
SURFACE WATER FEATURES

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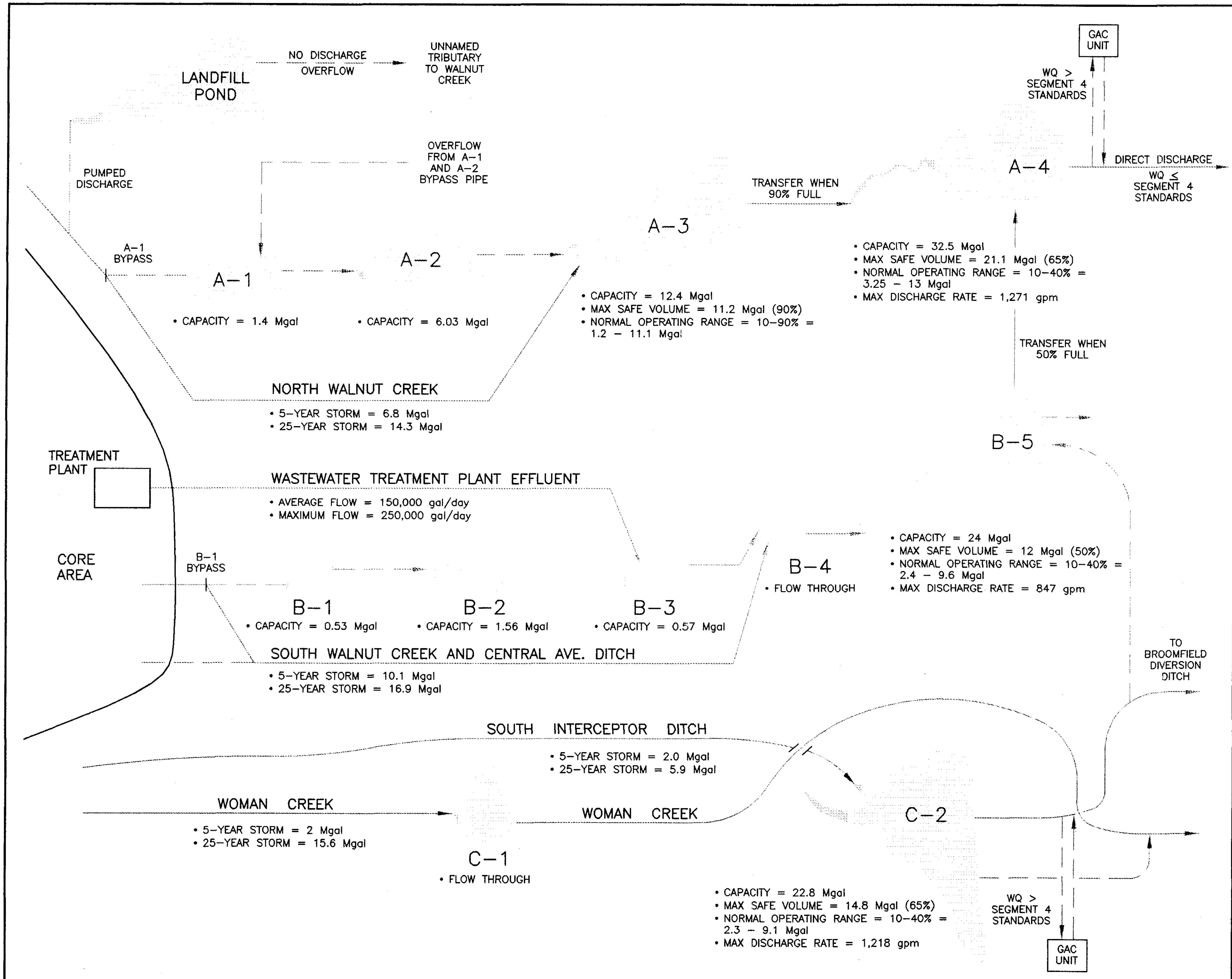
DATE	SEPTEMBER 30, 1994	SCALE	1"=2500'	–

FIGURE 2-3
ROUTING SCHEMATIC FOR ROUTINE POND OPERATIONS



MAP LEGEND

ROUTINE FLOW ROUTE

POSSIBLE FLOW ROUTE

≤ INDICATES WATER QUALITY MEETS STANDARDS

> INDICATES WATER QUALITY EXCEEDS STANDARDS

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DRAWN BY	KAL	APPROVED	–	OF
DATE	SEPTEMBER 30, 1994	SCALE	NOT TO SCALE	–

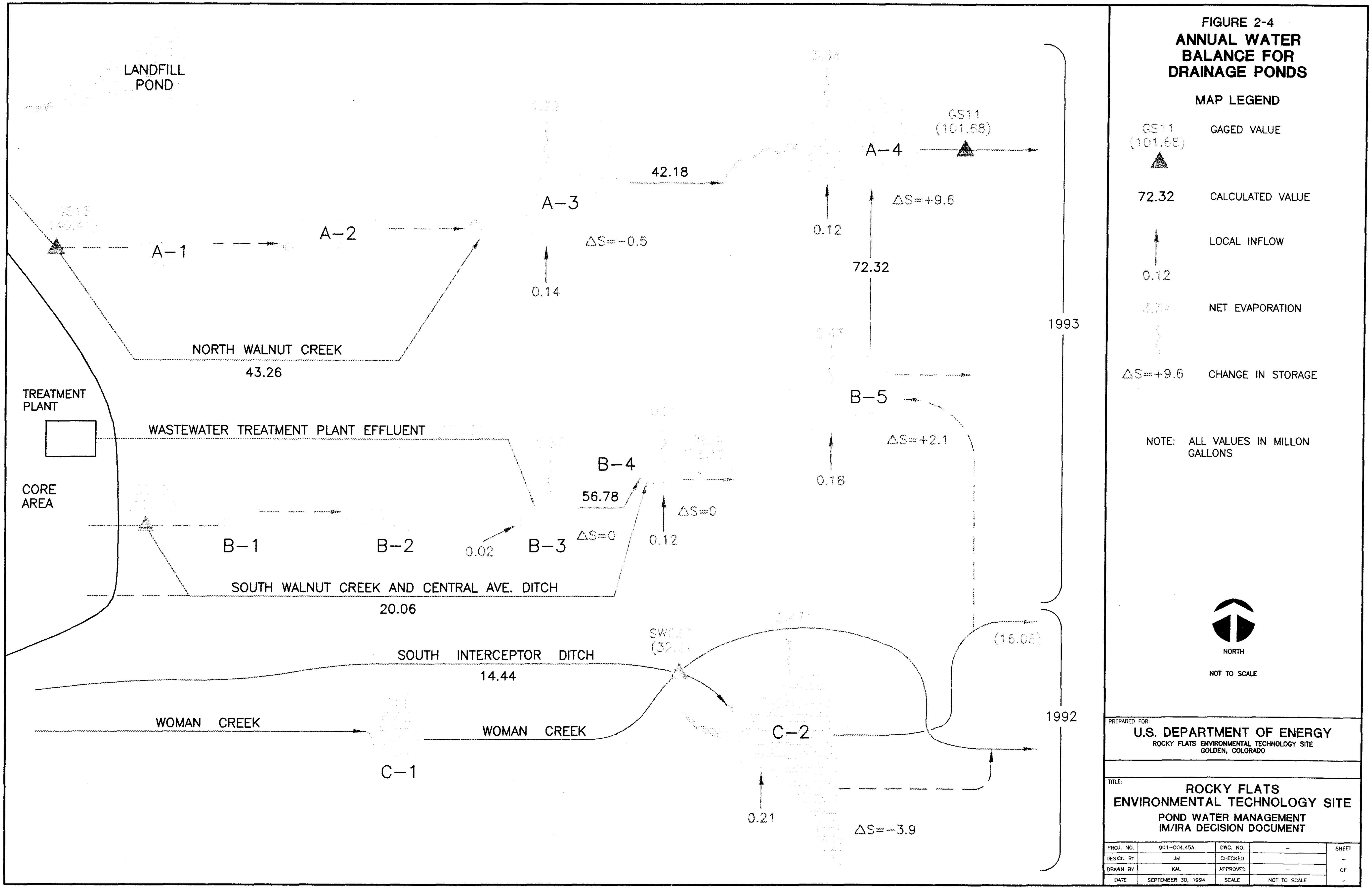

FIGURE 2-4
ANNUAL WATER BALANCE FOR DRAINAGE PONDS

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DESIGN BY	JM	CHECKED	-	-
DRAWN BY	KAL	APPROVED	-	OF
DATE	SEPTEMBER 30, 1994	SCALE	NOT TO SCALE	-

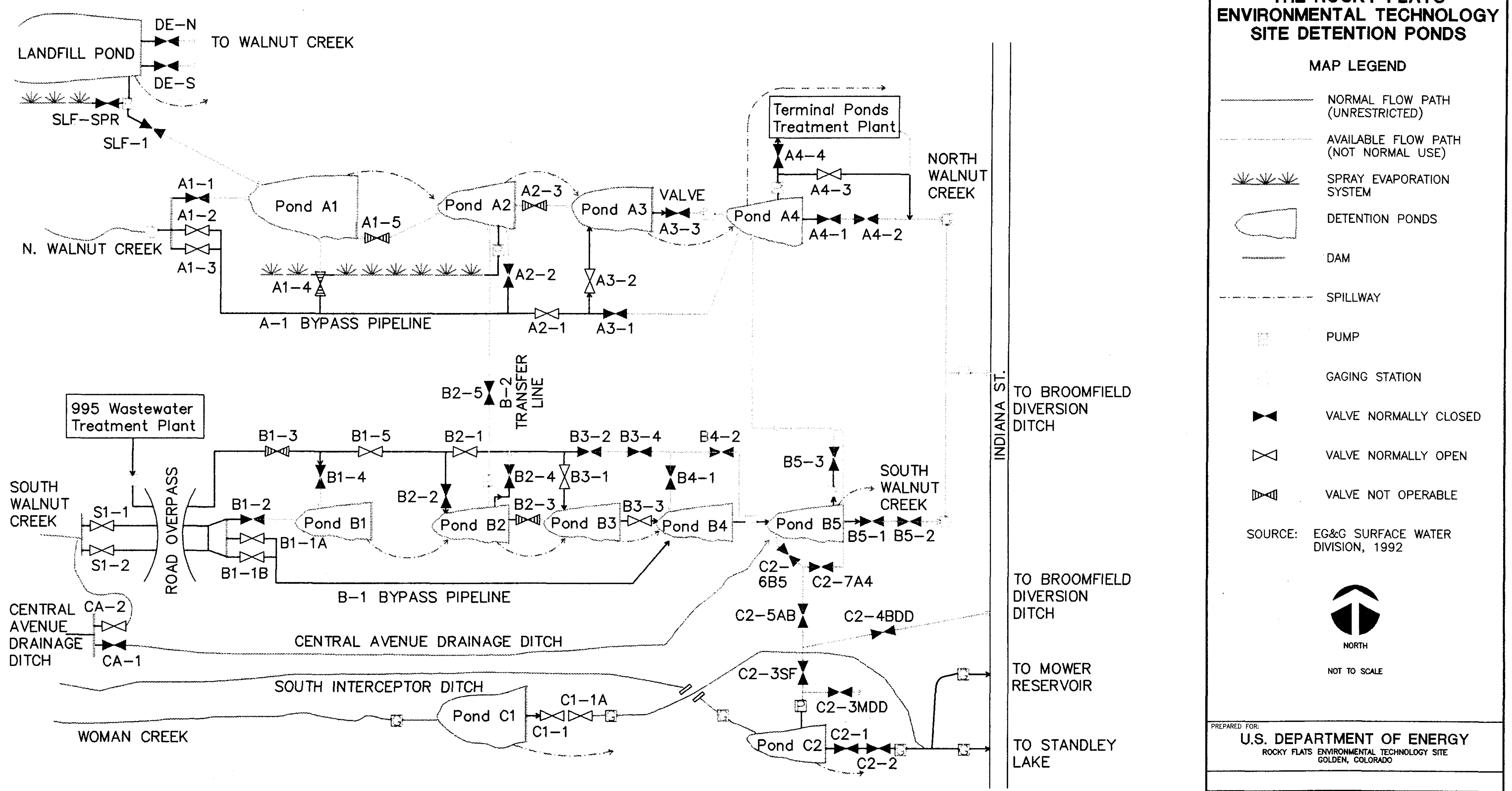

FIGURE 3-1
SCHEMATIC FOR CURRENT FLOW AND WATER TRANSFER NETWORK AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE DETENTION PONDS

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DRAWN BY	KAL	APPROVED	–	OF
DATE	SEPTEMBER 30, 1994	SCALE	NOT TO SCALE	–

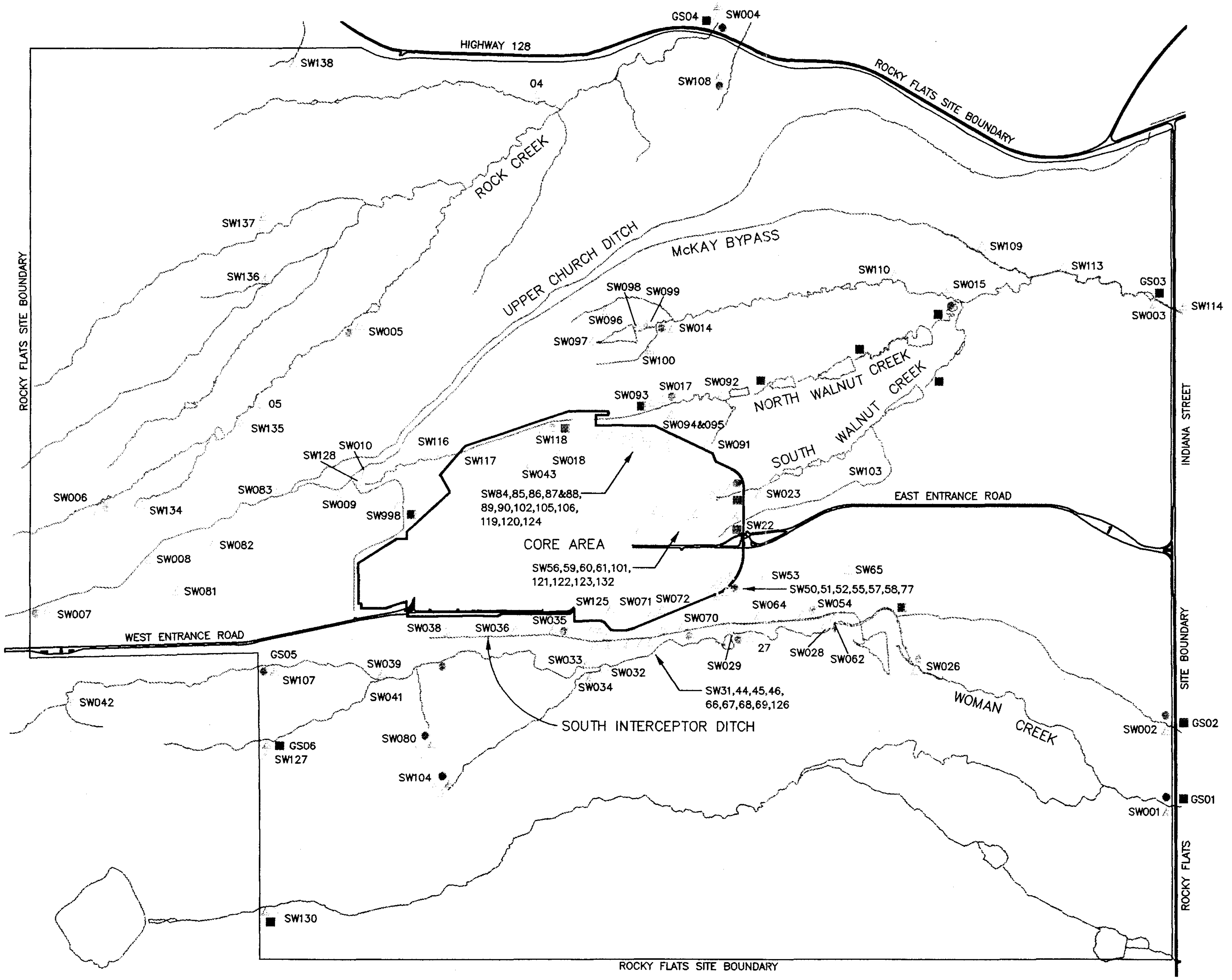

FIGURE 4-1
ON-SITE SURFACE WATER, STORMWATER AND SEDIMENT SAMPLING LOCATIONS

MAP LEGEND

- SEDIMENT SAMPLING LOCATIONS
- ROUTINE SURFACE WATER SAMPLING LOCATIONS
- BACKGROUND SURFACE WATER SAMPLING LOCATIONS
- NPDES STORMWATER SAMPLING STATIONS
- RECENTLY DISCONTINUED SURFACE WATER STATIONS
- STORMWATER SAMPLING STATIONS

NOTE: STATION NUMBERS REFER TO STATIONS LISTED IN TABLES 4-1 AND 4-3

NORTH

GRAPHIC SCALE
2000 1000 500 0 500 1000 2000
SCALE IN FEET

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DESIGN BY	JKC	CHECKED	-	-
DRAWN BY	KAL	APPROVED	-	OF
DATE	SEPTEMBER 30, 1994	SCALE	1"=2000'	-

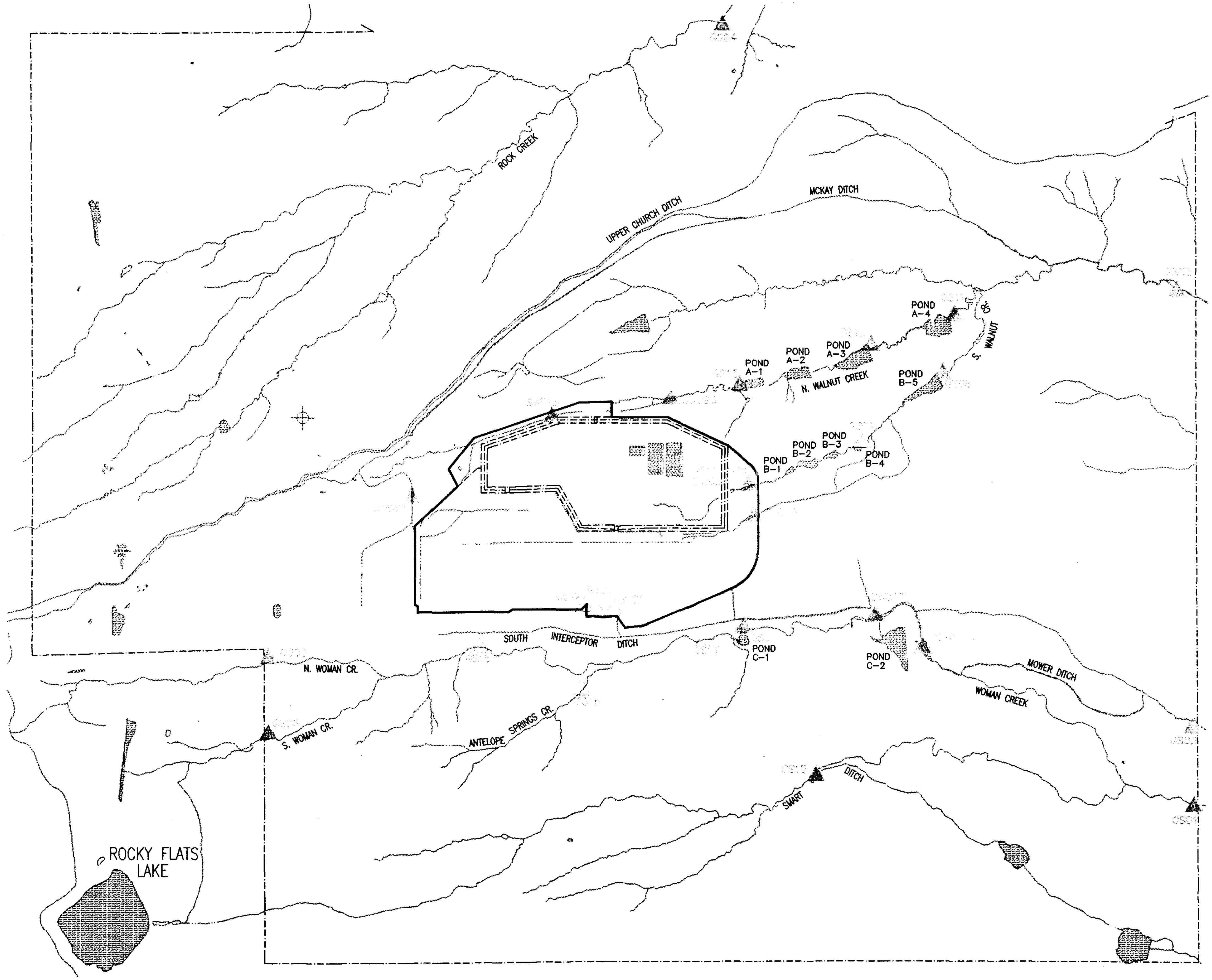

FIGURE 4-2

GAGING STATIONS AND STORMWATER MONITORING LOCATIONS

MAP LEGEND

- GAGING AND SAMPLING STATIONS AUGUST 1993
- STATIONS ADDED IN 1993
- SECURITY FENCE
- STREAMS, DITCHES AND DRAINAGE FEATURES
- INDUSTRIAL AREA
- 61-METER METEROLOGICAL TOWER

NORTH

GRAPHIC SCALE

1800 900 450 0 450 900 1800

SCALE IN FEET

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DATE	SEPTEMBER 30, 1994	SCALE	1"=1800'	-

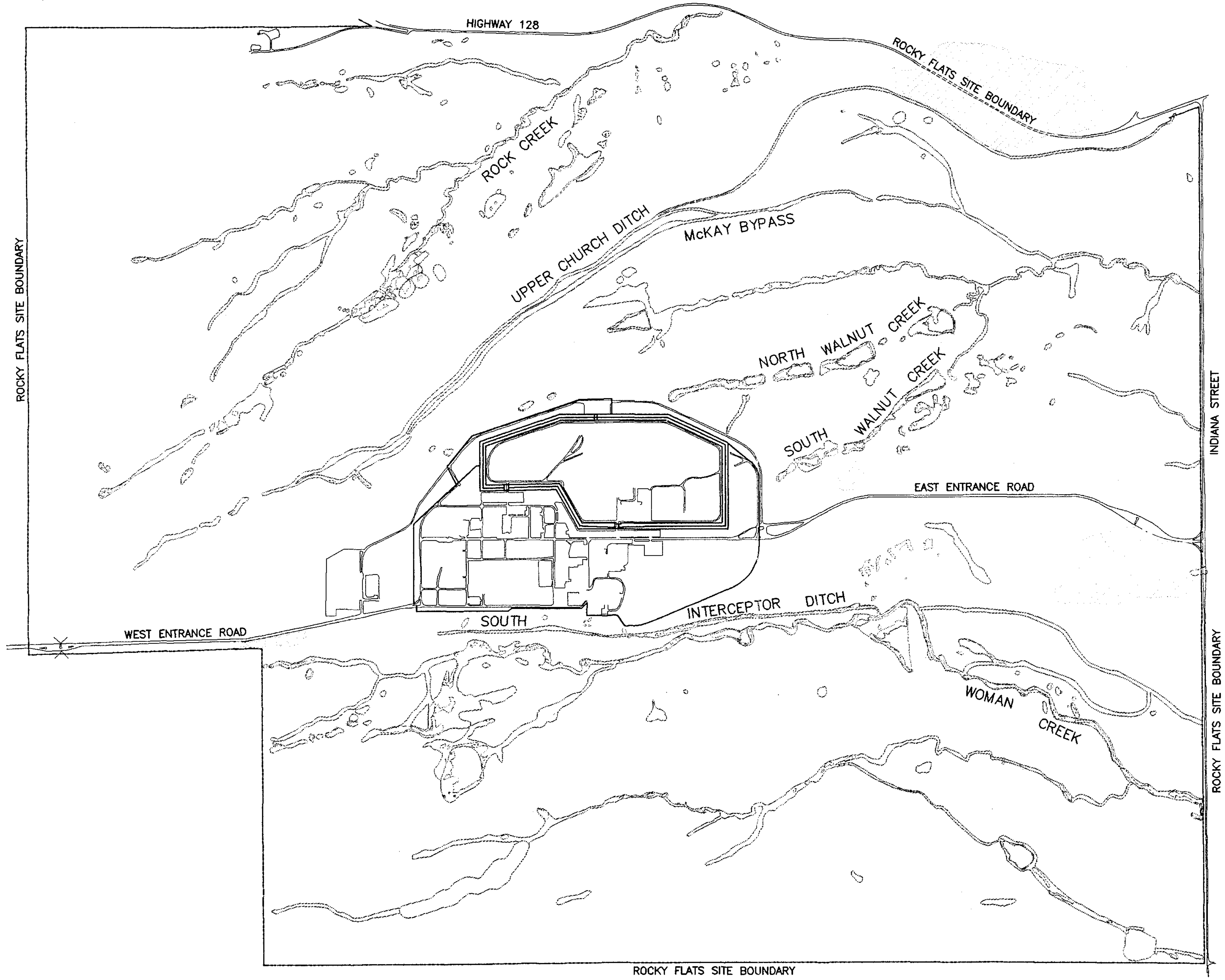

FIGURE 5-1

SENSITIVE HABITAT AREAS AT ROCKY FLATS

MAP LEGEND

- WETLANDS*
- POTENTIAL UTE LADIES' TRESSES ORCHID HABITAT*
- POTENTIAL RAPTOR FORAGING AREAS
- POTENTIAL FORKTIP THREE AWN GRASS AREA

NOTE: NO HERBICIDE WILL BE APPLIED IN ANY OF THE AREAS SHOWN ON THIS FIGURE.

* FROM: DRAFT SENSITIVE HABITAT MAPS BY EP/END

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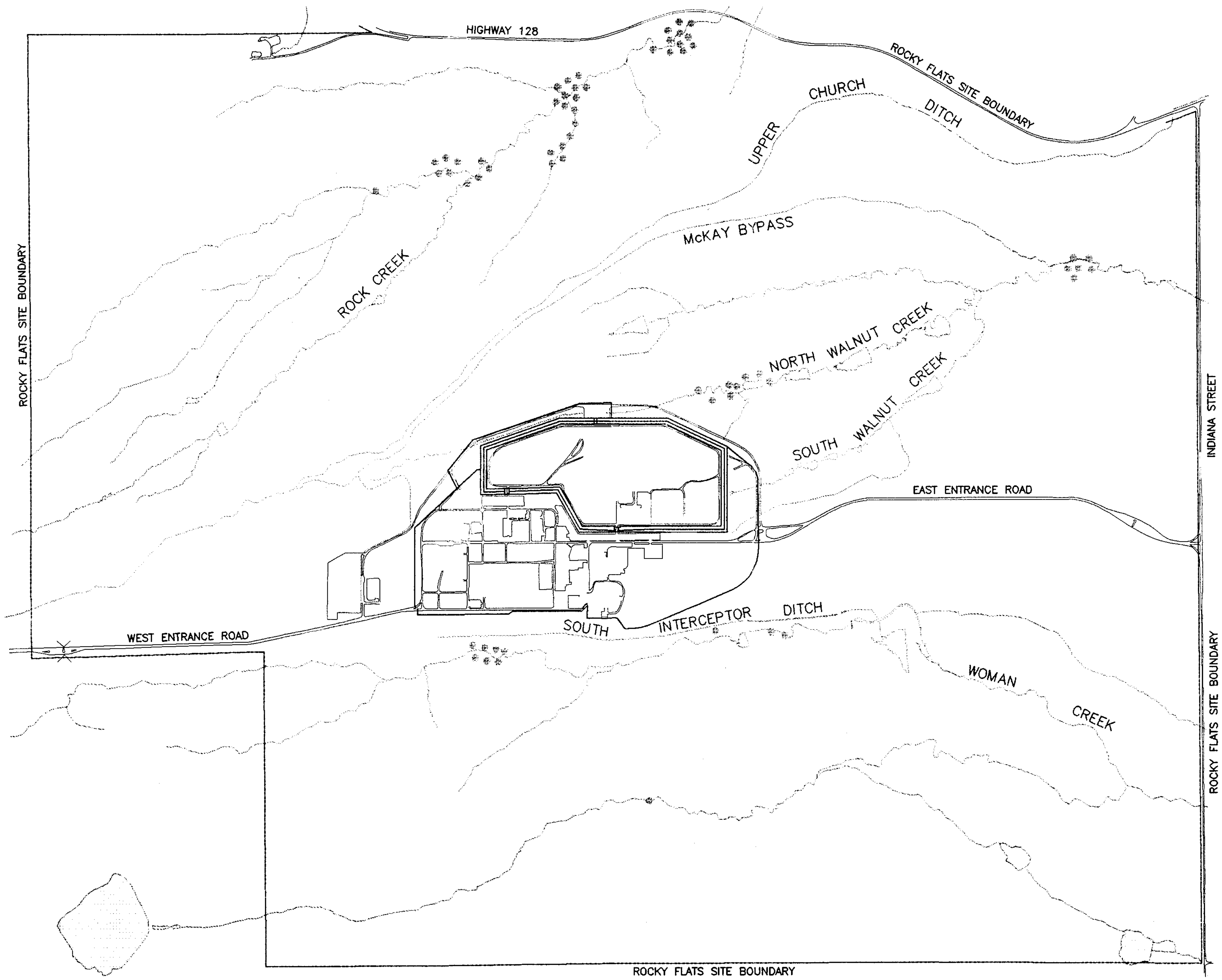
DESIGN BY	EAB	CHECKED	EAB	–
DRAWN BY	KAL	APPROVED	–	OF
DATE	SEPTEMBER 30, 1994	SCALE	1"=2000'	–



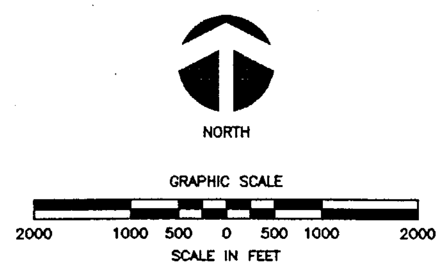


FIGURE 5-2

CAPTURE LOCATIONS OF PREBLE'S MEADOW JUMPING MOUSE AND ITS PROBABLE RANGE

MAP LEGEND

PROBABLE RANGE

RECORDS OF PREBLE'S MEADOW JUMPING MOUSE (ZAPUS HUDSONIUS PREBLEI)

DATA SOURCE: RECORDS OF PREBLE'S MEADOW JUMPING MOUSE AND PROBABLE RANGE, PROVIDED BY ALISON DEANS OF EP/EWM – 1994.

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DRAWN BY	KAL	APPROVED	–	OF
DATE	SEPTEMBER 30, 1994	SCALE	1"=2000'	–

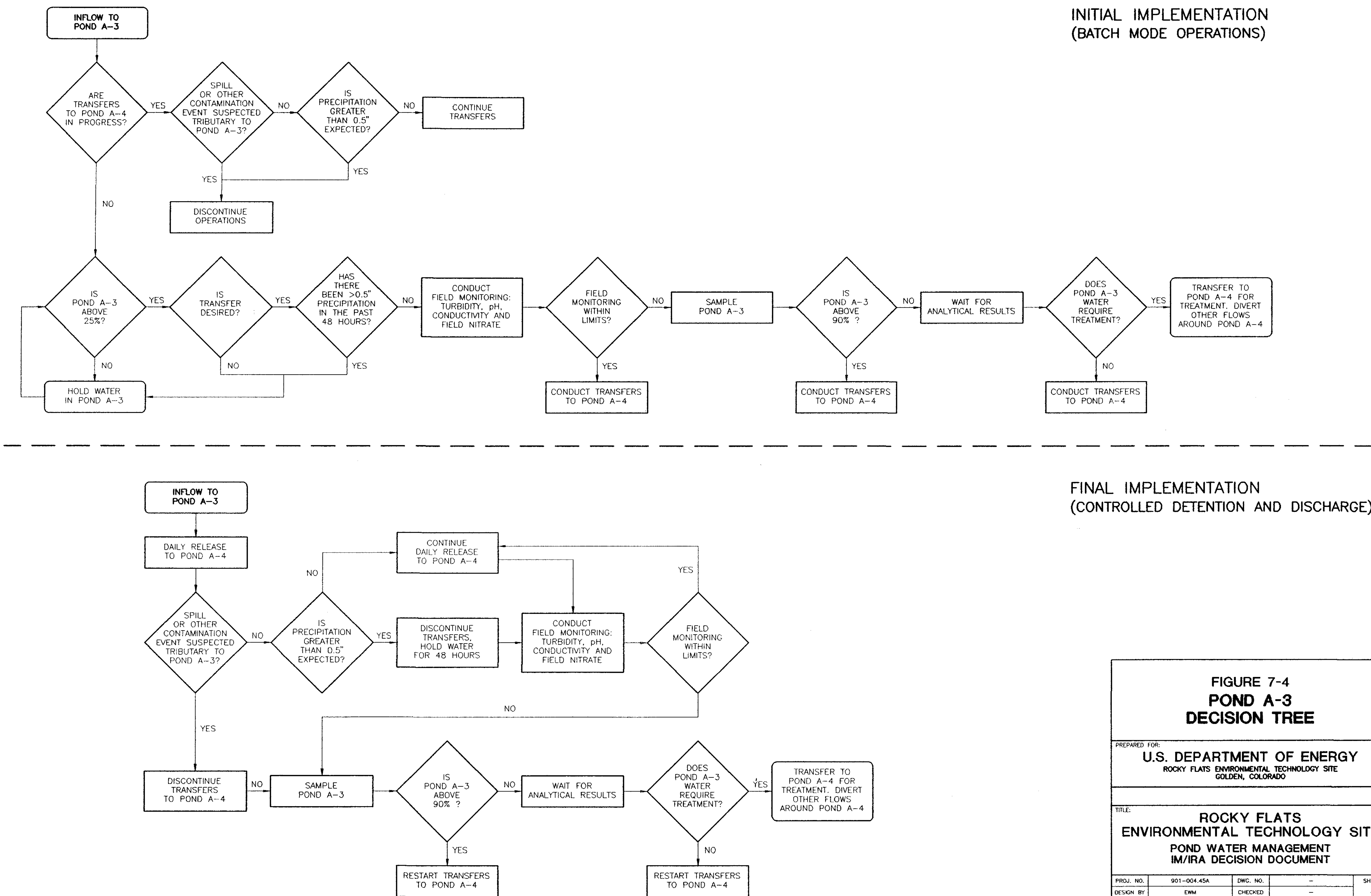

FIGURE 7-4
POND A-3 DECISION TREE

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DRAWN BY	KAL	APPROVED	–	OF
DATE	OCTOBER 14, 1994	SCALE	–	–

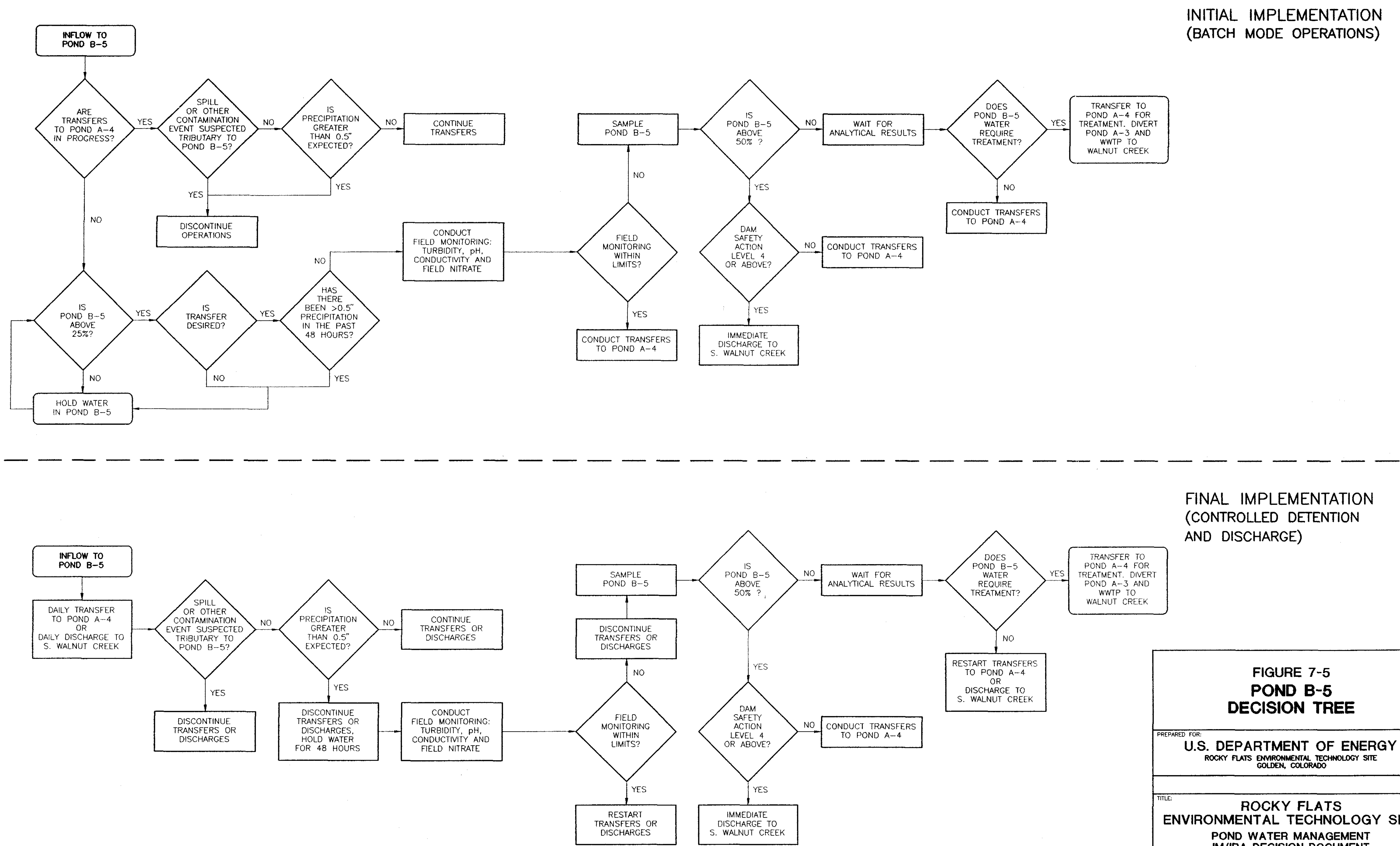

FIGURE 7-5
POND B-5 DECISION TREE

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PROJ. NO.	901-004.45A	DWG. NO.	-	SHEET
DESIGN BY	EWM	CHECKED	-	-
DRAWN BY	KAL	APPROVED	-	OF
DATE	OCTOBER 14, 1994	SCALE	-	-

INITIAL IMPLEMENTATION
(BATCH MODE OPERATIONS)

FINAL IMPLEMENTATION
(CONTROLLED DETENTION AND DISCHARGE)

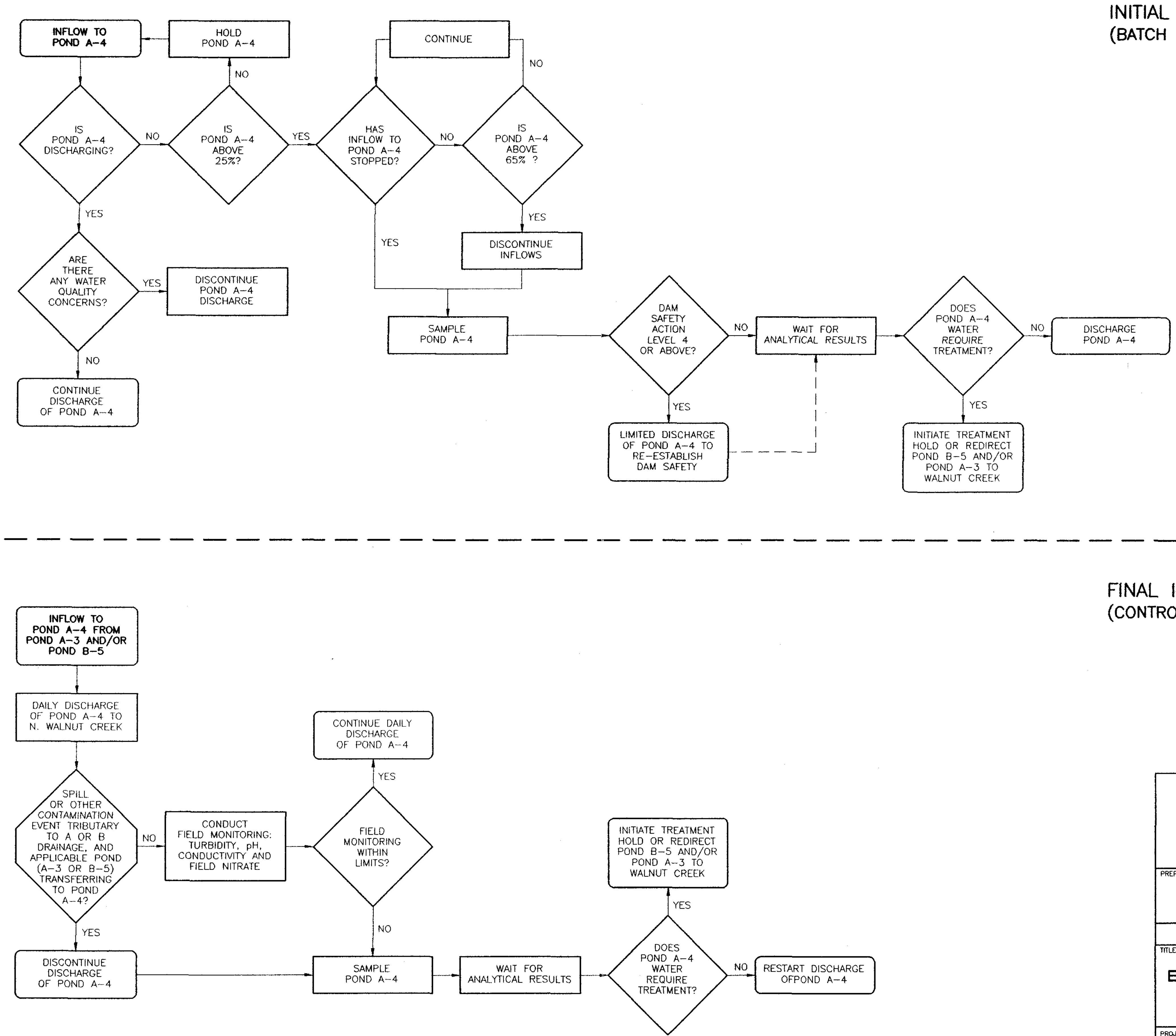

FIGURE 7-6
POND A-4
DECISION TREE

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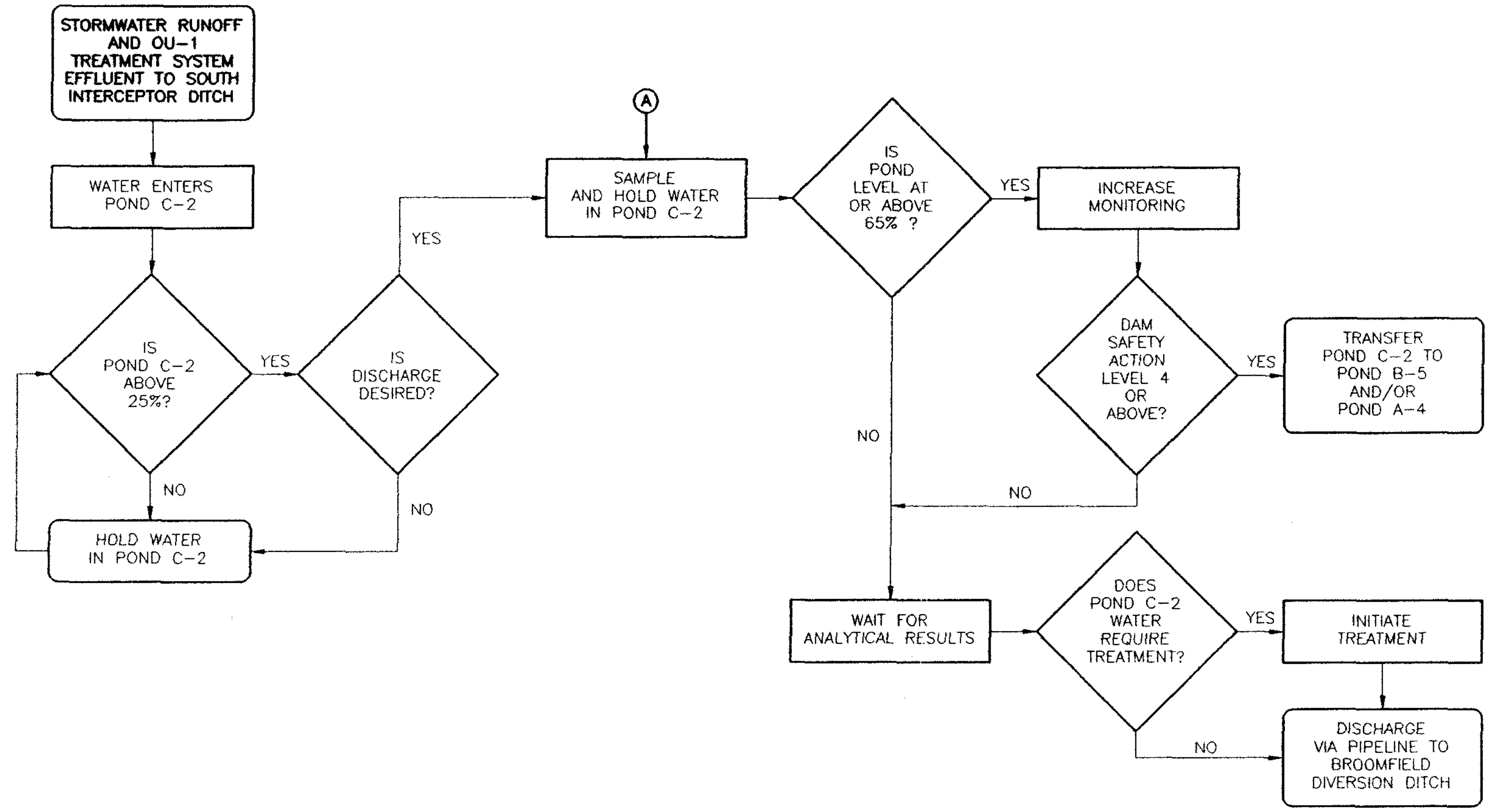
DESIGN BY	EWM	CHECKED	–	–
DRAWN BY	KAL	APPROVED	–	OF
DATE	OCTOBER 14, 1994	SCALE	–	–



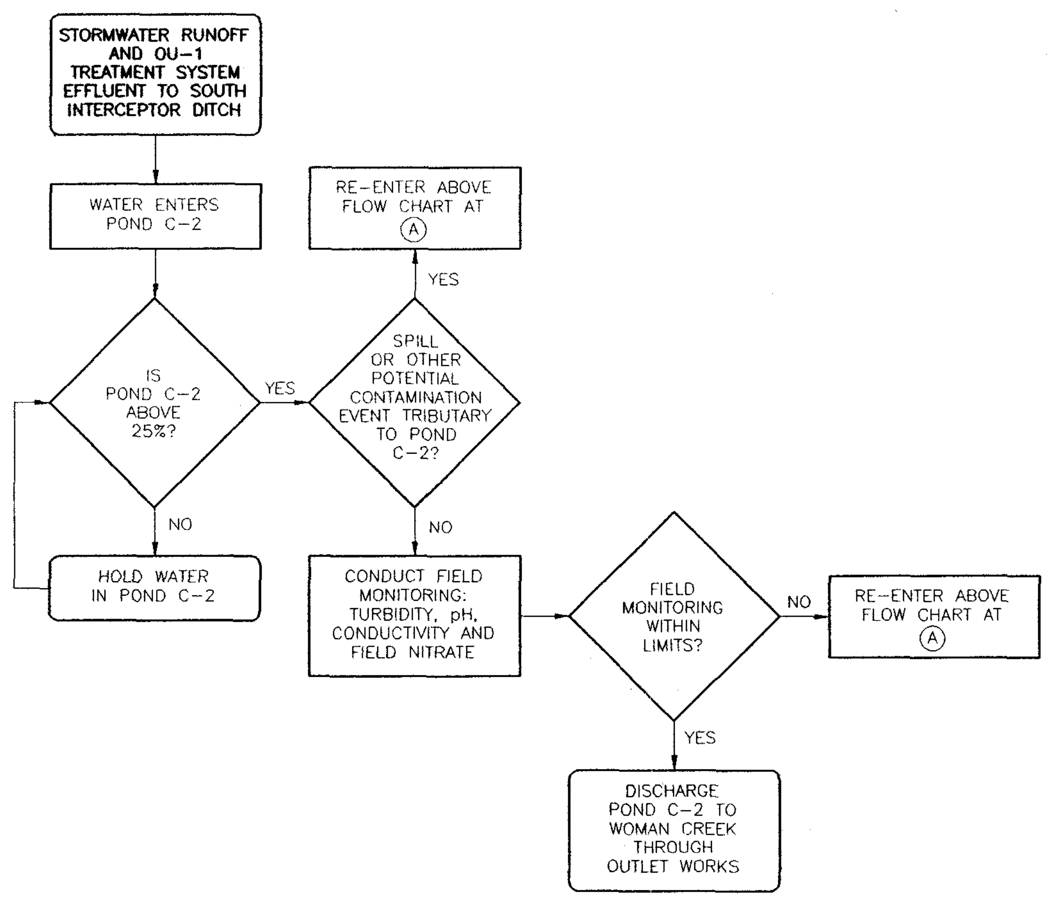


FIGURE 7-7
POND C-2
DECISION TREE

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DESIGN BY	EWM	CHECKED	-	-
DRAWN BY	KAL	APPROVED	-	OF
DATE	OCTOBER 14, 1994	SCALE	-	-